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Shimizu et al.

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(45) **Date of Patent: Aug. 23, 2022**

(54) **DRUM CARTRIDGE AND DEVELOPING CARTRIDGE CAPABLE OF SUPPRESSING VARIATION IN POSITION OF ELECTRICAL CONTACT SURFACE**

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(30) **Foreign Application Priority Data**

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Dec. 22, 2016 (JP) 2016-249651

(51) **Int. Cl.**
G03G 21/18 (2006.01)
G03G 15/08 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 21/1814*** (2013.01); ***G03G 15/0863*** (2013.01); ***G03G 15/0865*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC G03G 15/0863; G03G 15/0865; G03G 21/1814; G03G 21/1825; G03G 2215/0697; G03G 2215/085
See application file for complete search history.

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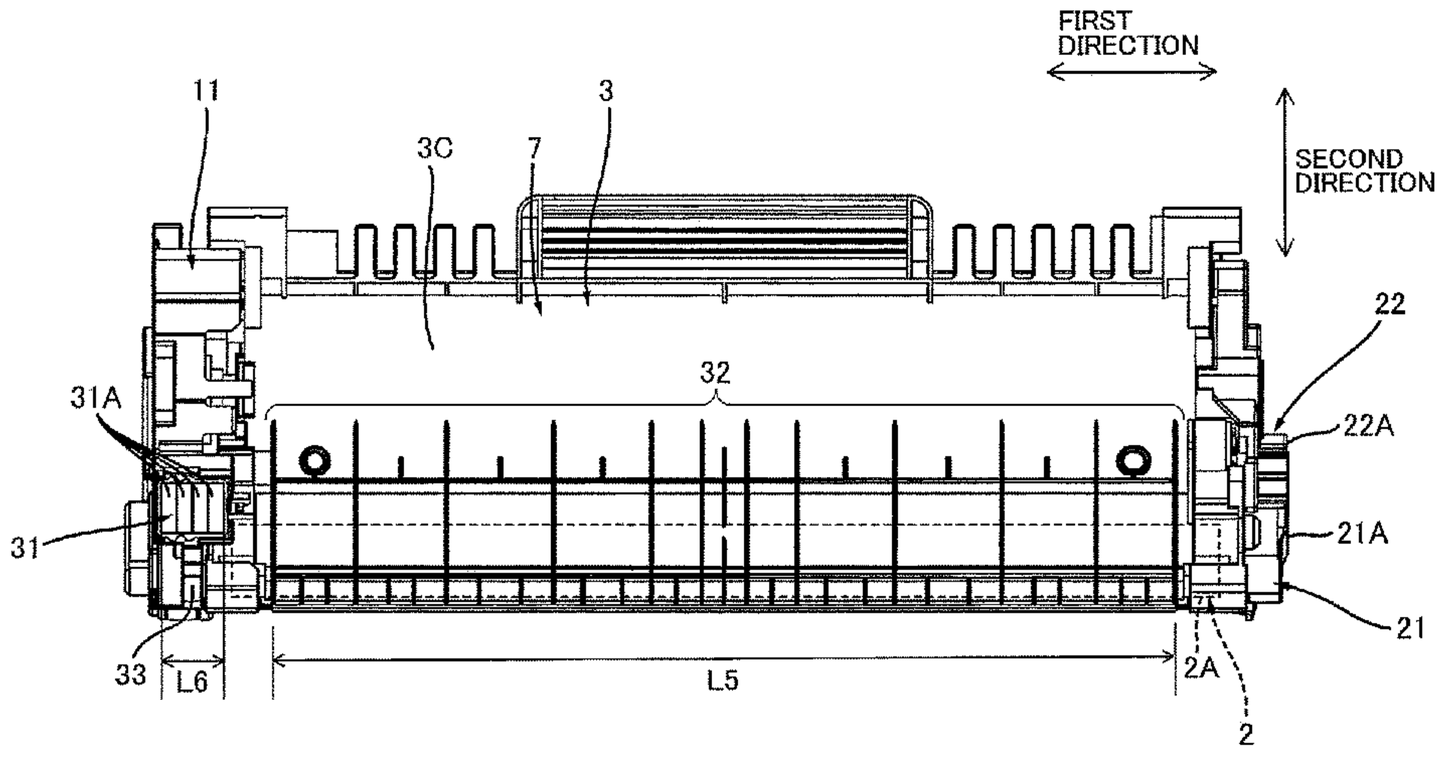
(57) **ABSTRACT**

A drum cartridge includes: a drum frame to which a developing cartridge including a storage medium having an electrical contact surface is detachably attachable; a photosensitive drum; a transfer roller; and a conveying roller. The drum is rotatable about a first axis extending in a first direction and positioned at one end portion of the frame in a second direction. The transfer roller is rotatable about a second axis extending in the first direction and in contact with the drum. The conveying roller is rotatable about a third axis extending in the first direction and separated from the transfer roller in the second direction. A first opening of the frame is positioned between the transfer roller and the conveying roller in the second direction. The electrical contact surface is exposed to an outside through the first
(Continued)



opening in a case where the developing cartridge is attached to the frame.

8 Claims, 18 Drawing Sheets

Related U.S. Application Data

continuation of application No. 16/438,882, filed on Jun. 12, 2019, now Pat. No. 10,514,655, which is a continuation of application No. 16/168,974, filed on Oct. 24, 2018, now Pat. No. 10,338,520, which is a continuation of application No. 15/472,014, filed on Mar. 28, 2017, now Pat. No. 10,126,704.

(52) **U.S. Cl.**

CPC . ***G03G 21/1825*** (2013.01); *G03G 2215/0697* (2013.01); *G03G 2215/085* (2013.01)

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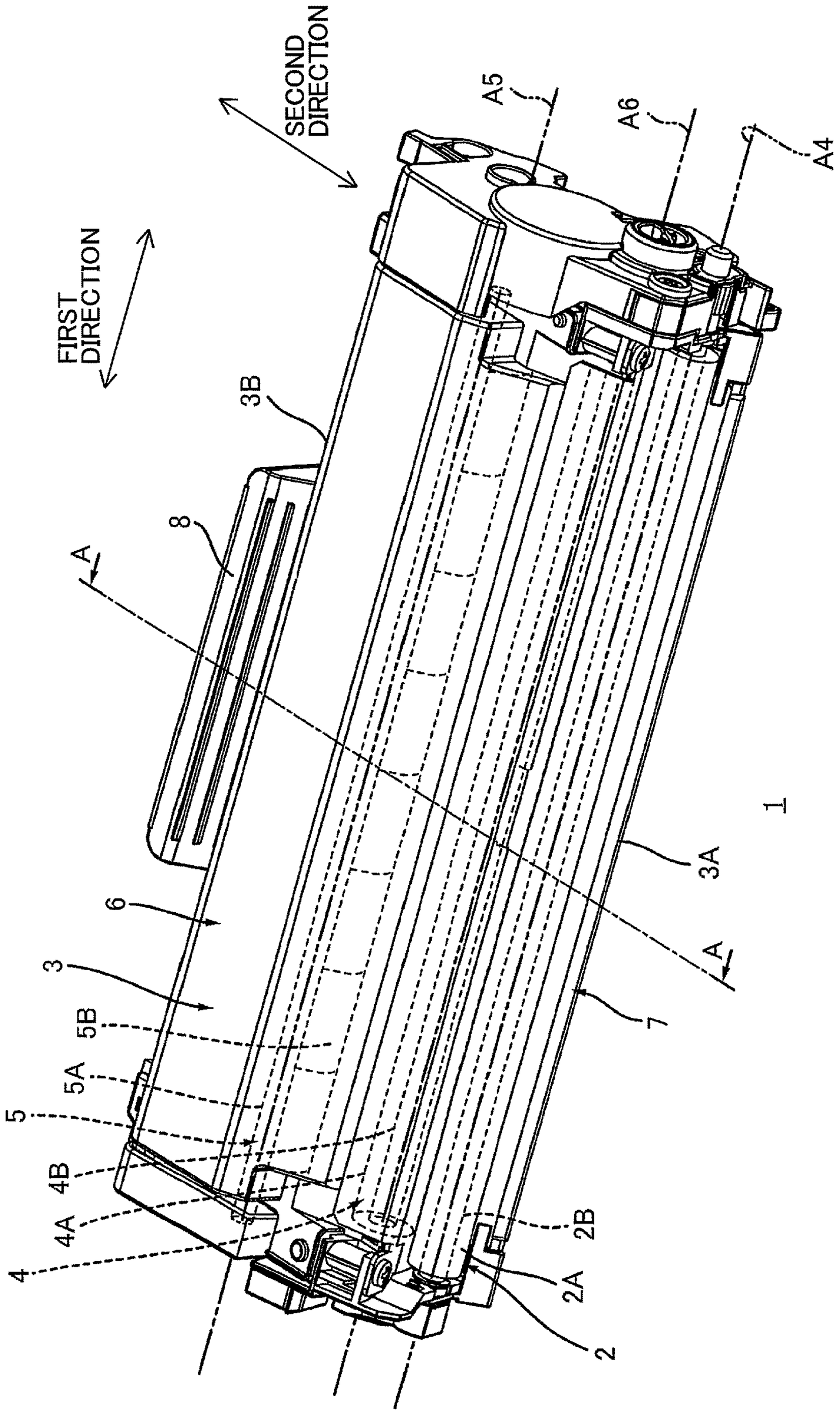
FIG. 1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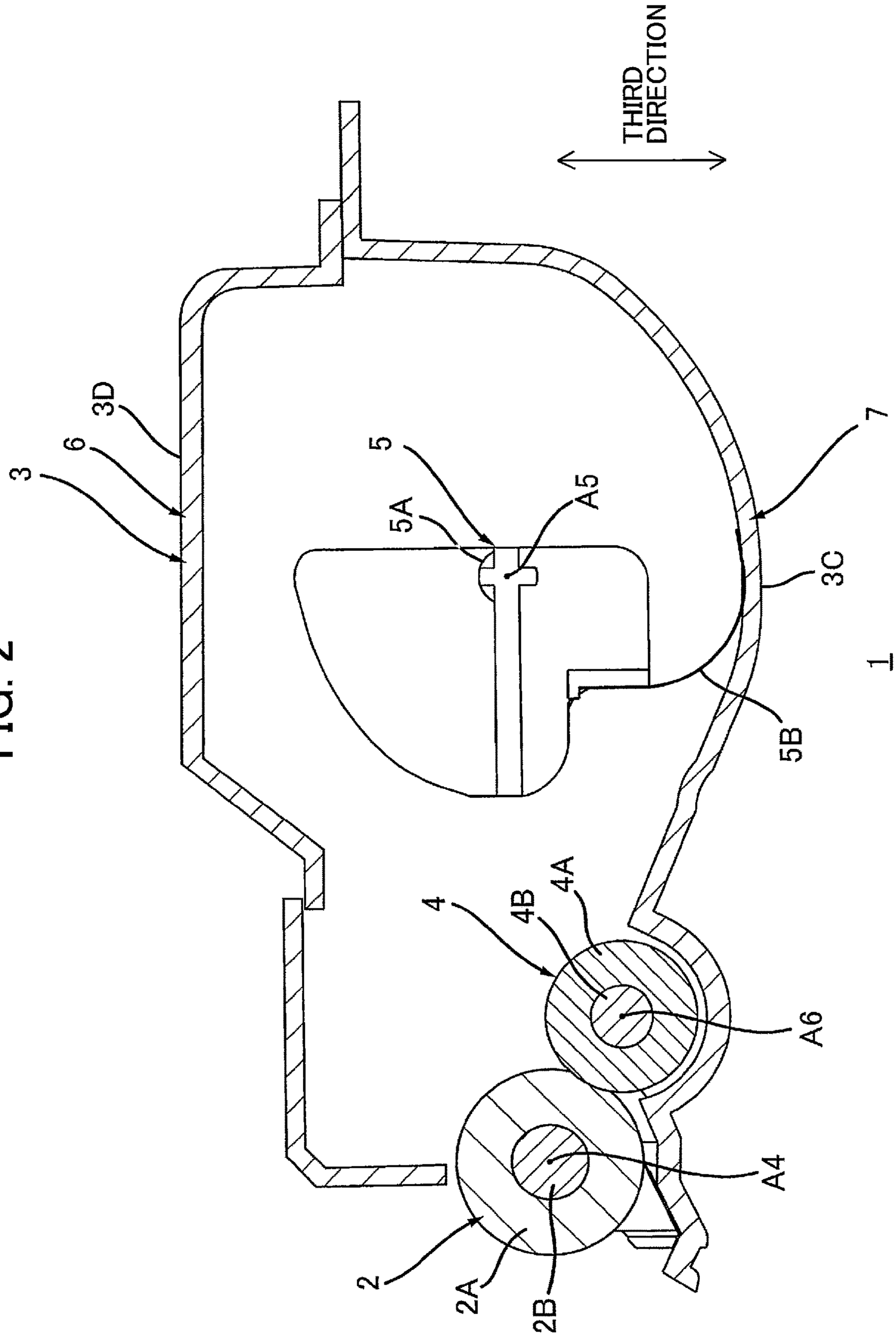
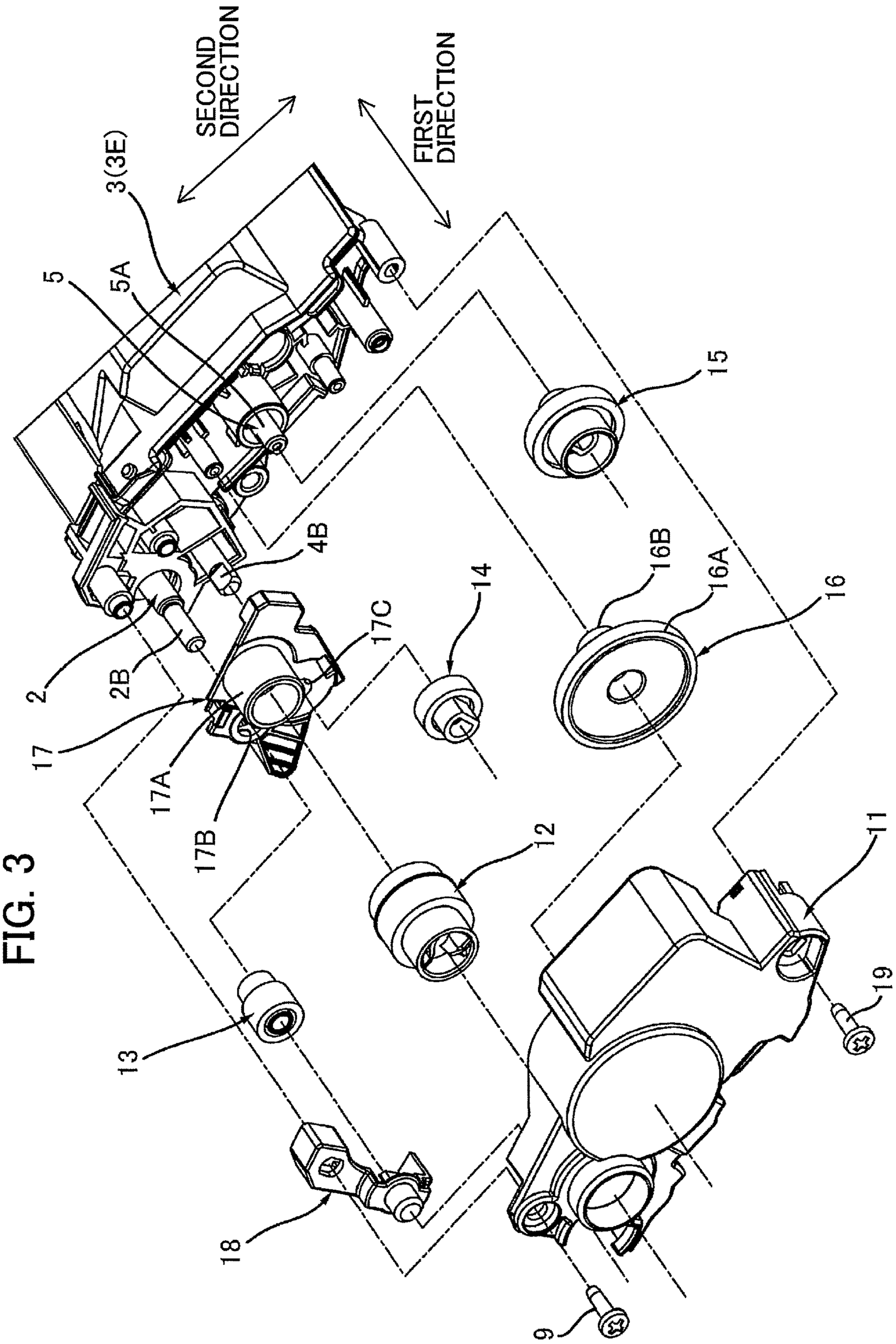
FIRST DIRECTION
A5
A6
A4
3B
8
A
6
3
5B
5A
5
4B
4A
4
1
3A
A
7
2B
2A
2

FIG. 2

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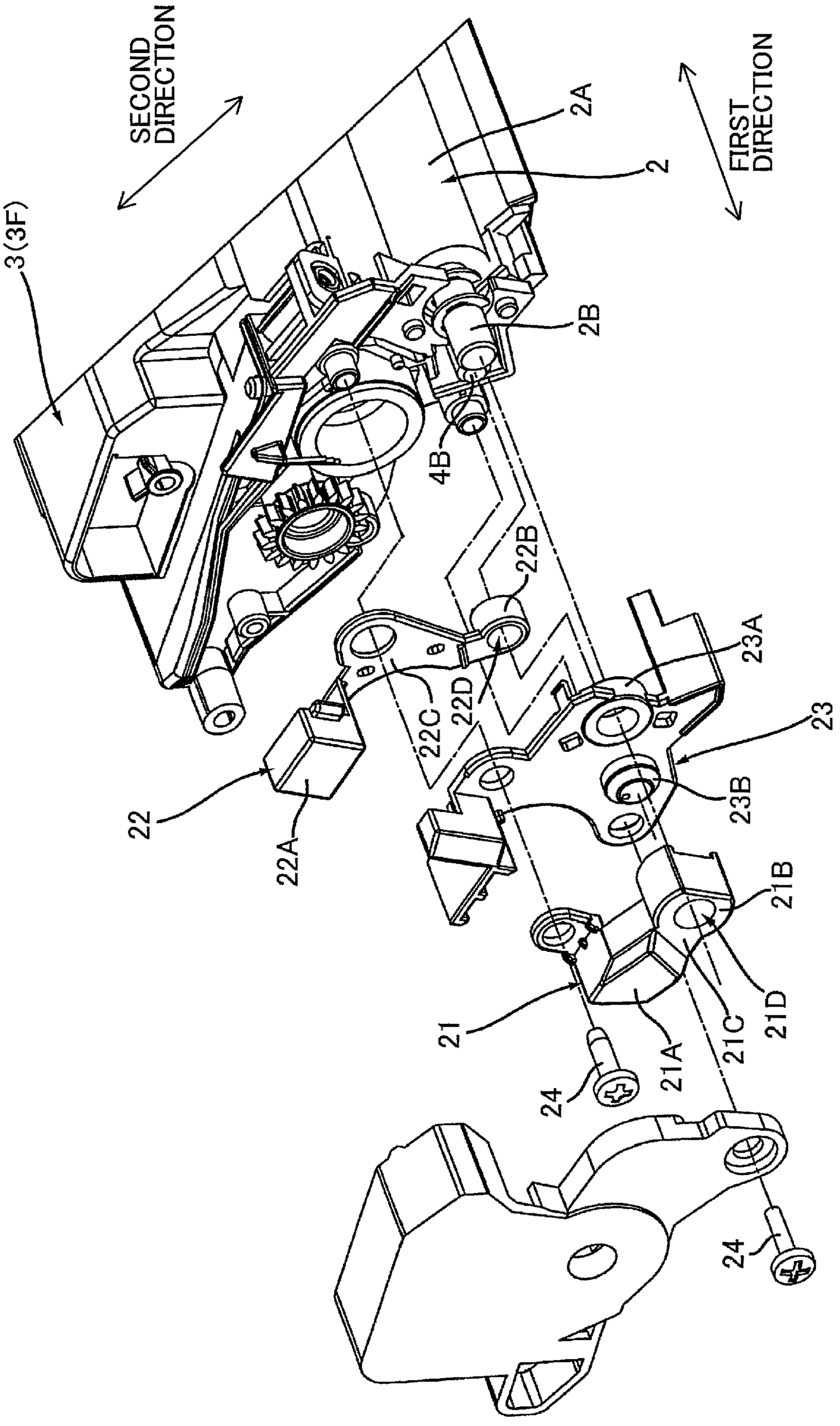
FIRST DIRECTION
3(3E)
5
5A
2
2B
17
17A
17B
17C
4B
14
15
16
16B
16A
12
11
13
18
19
19

FIG. 3

FIG. 4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23A
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23B
21B
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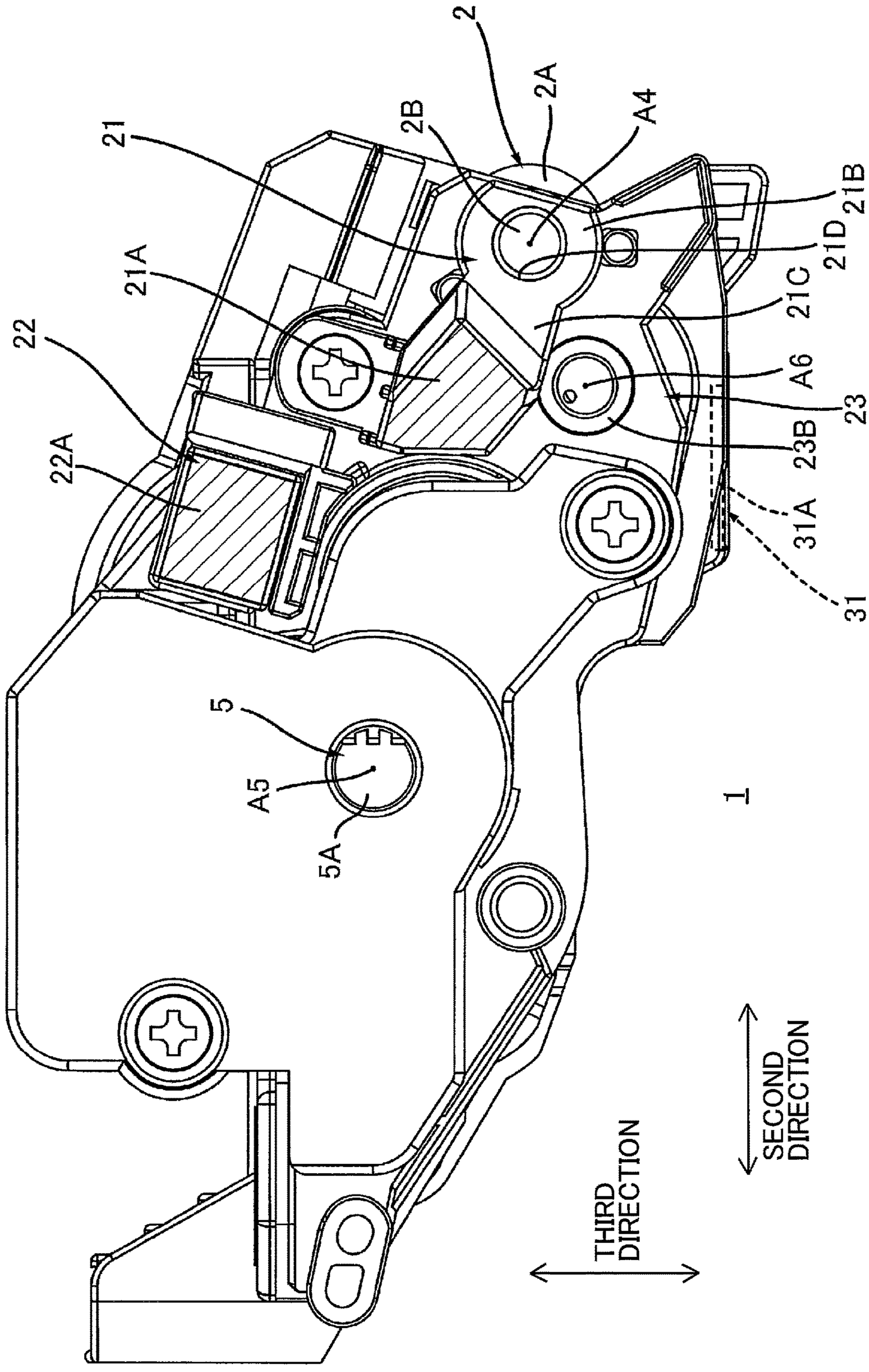
21A
21C
21D
24
24

FIG. 5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2A
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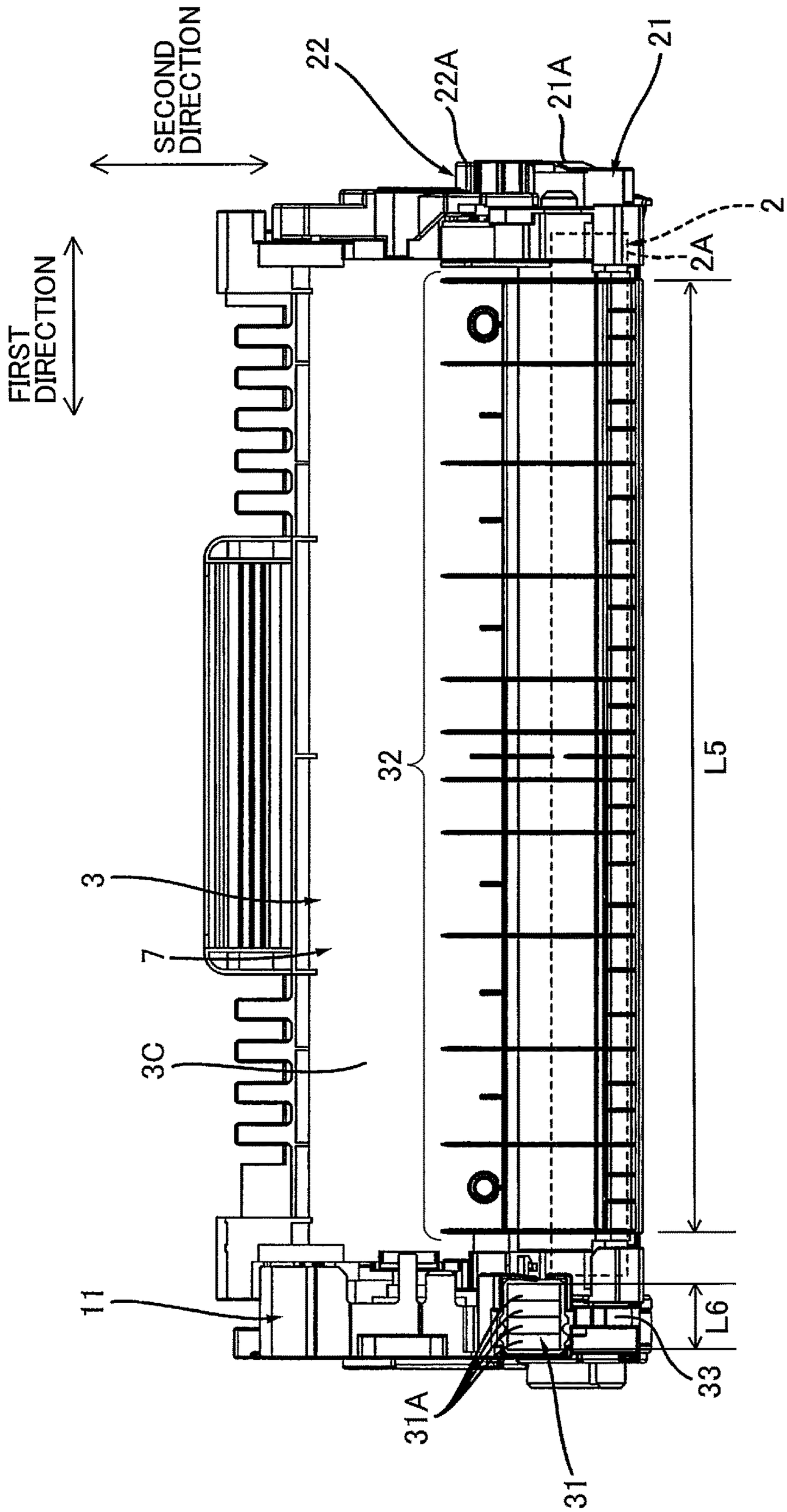
21
21B
21D
21C
21A
22
A6
23
22A
23B
31A
31
5
A5
5A
1
THIRD DIRECTION
SECOND DIRECTION

FIG. 6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FIRST DIRECTION
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22A
21A
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2
2A
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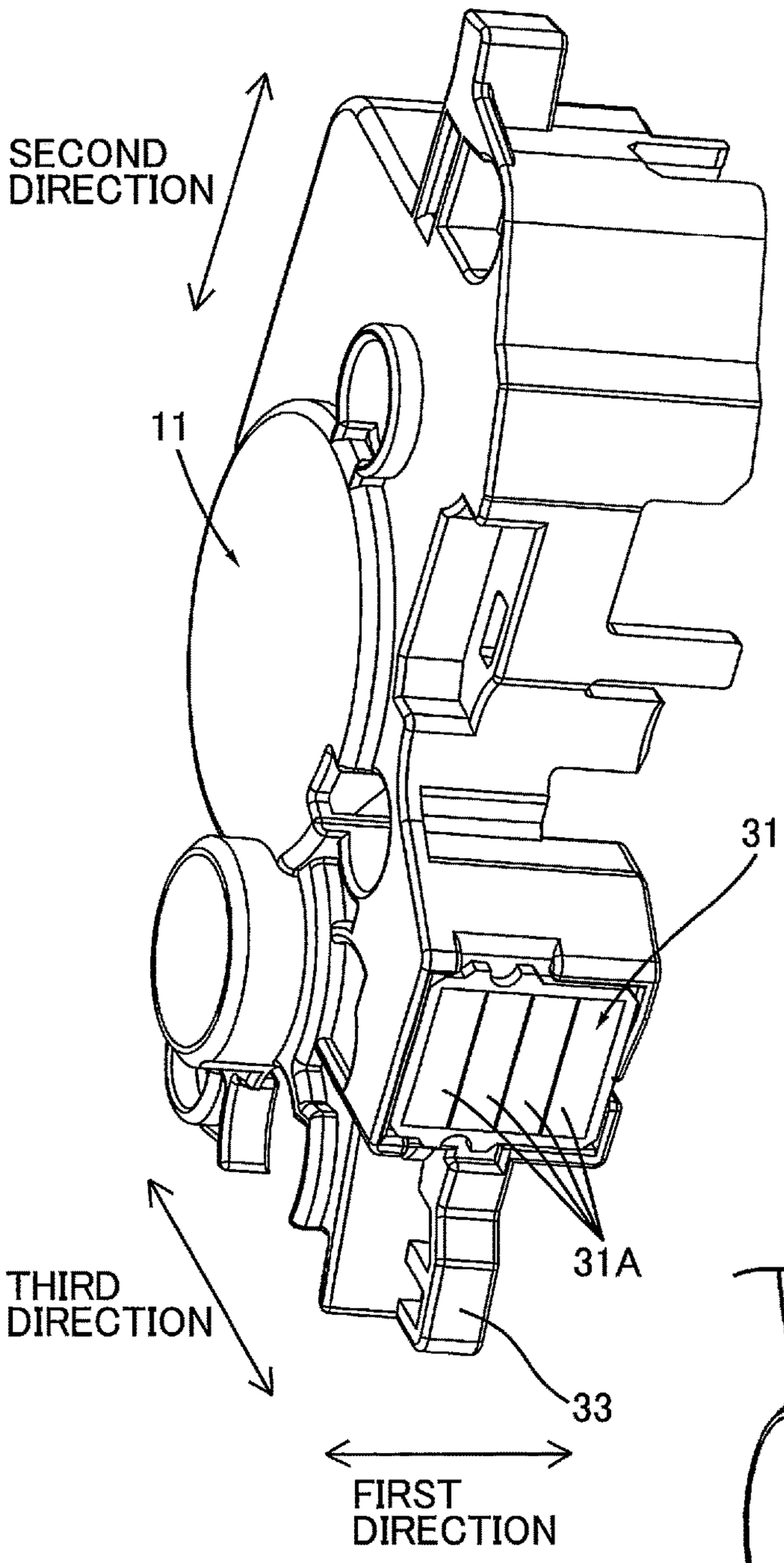
7
3C
11
31A
31
33
L6

FIG. 7A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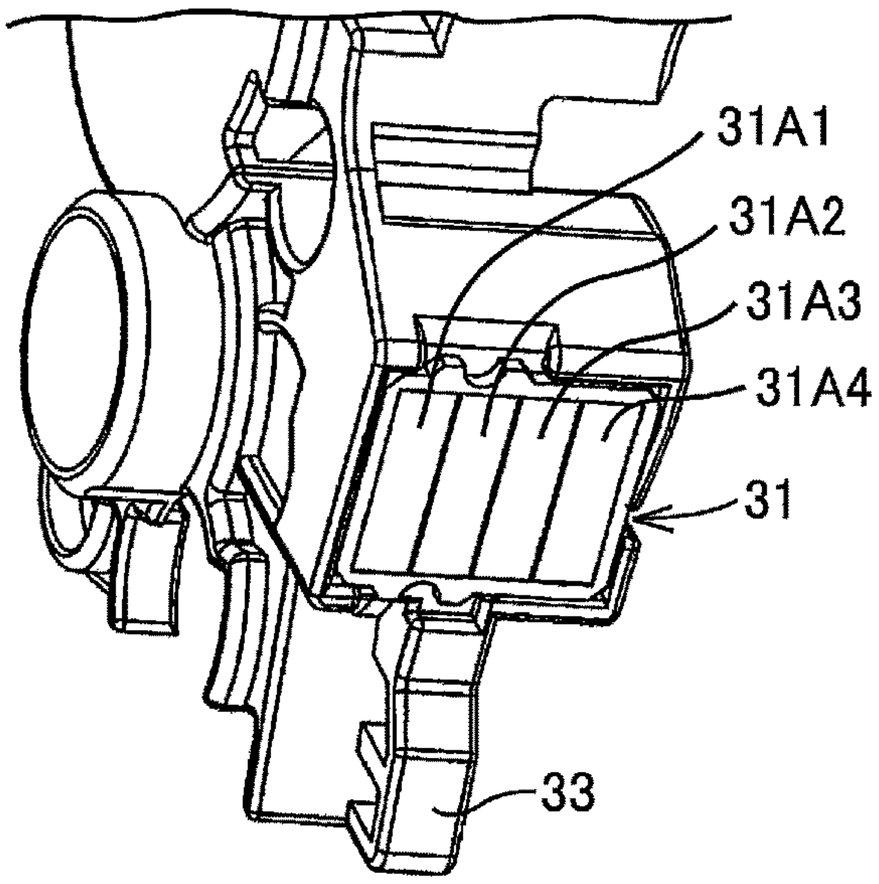
THIRD DIRECTION
FIRST DIRECTION

FIG. 7B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31A2
31A3
31A4
31
33

FIG. 8

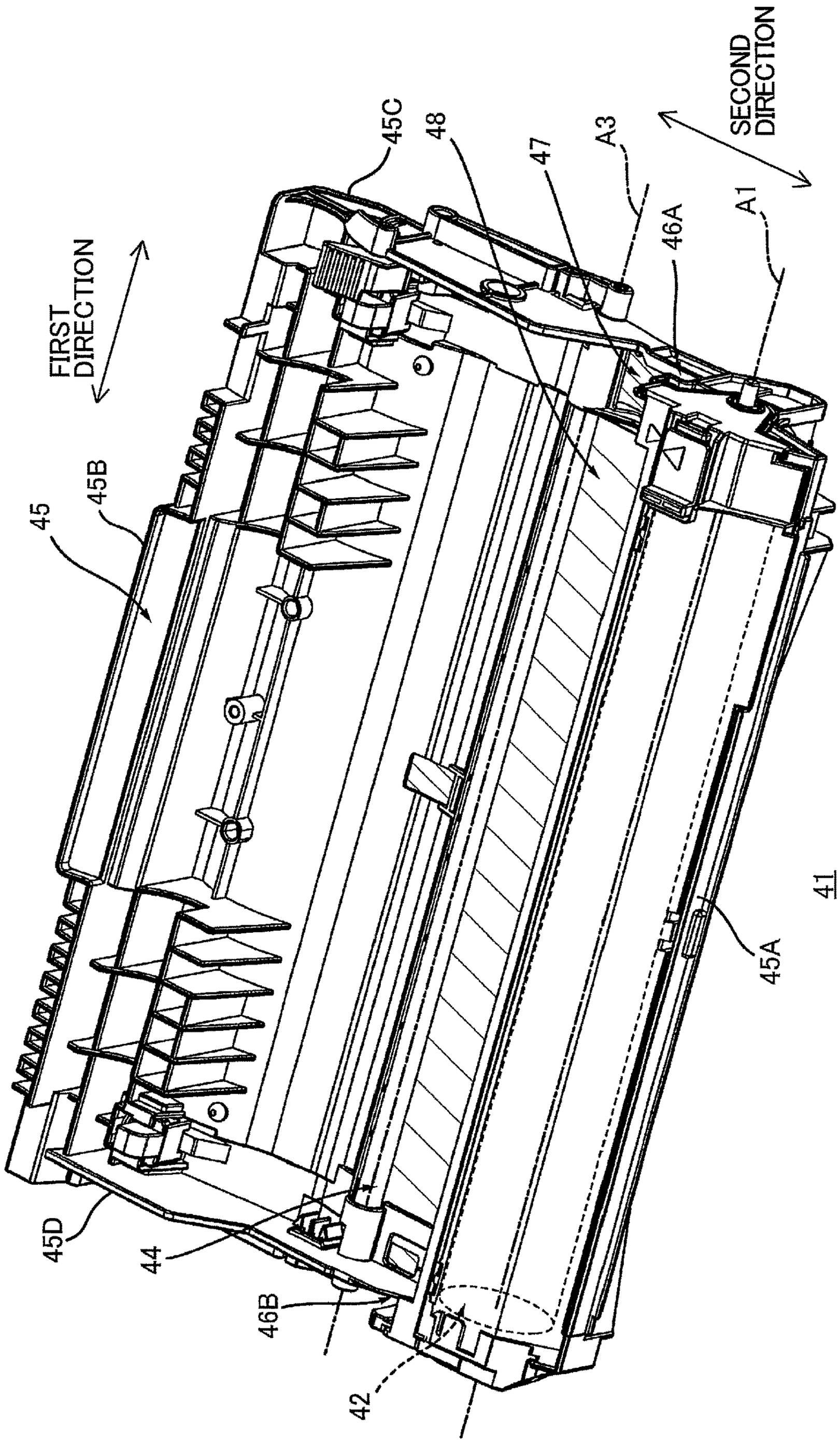
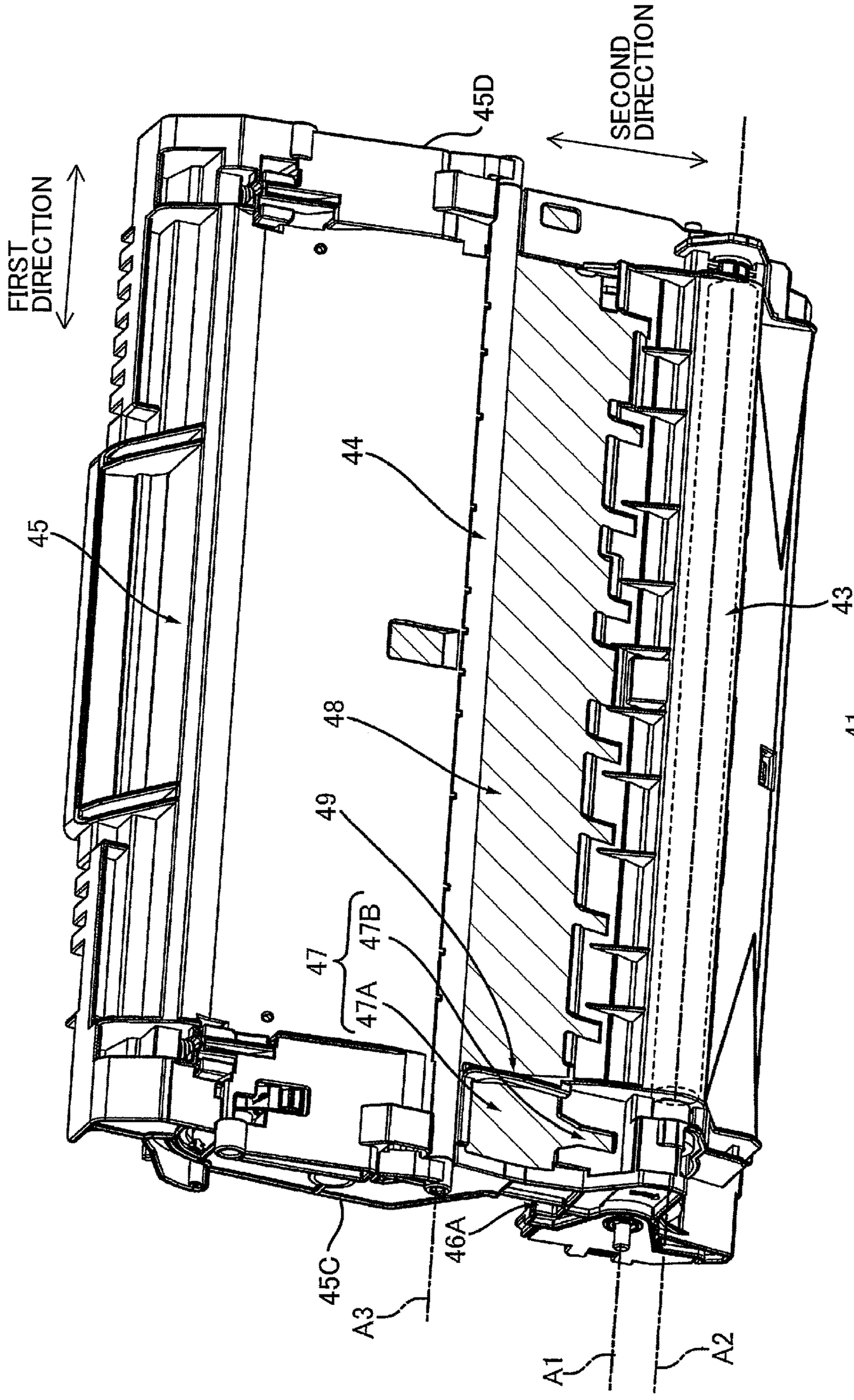

45C
48
47
A3
SECOND DIRECTION
46A
A1
FIRST DIRECTION
45
45B
45D
44
46B
42
45A
41

FIG. 9


FIRST DIRECTION
SECOND DIRECTION
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48
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47B
47A
43
41
45C
A3
46A
A1
A2

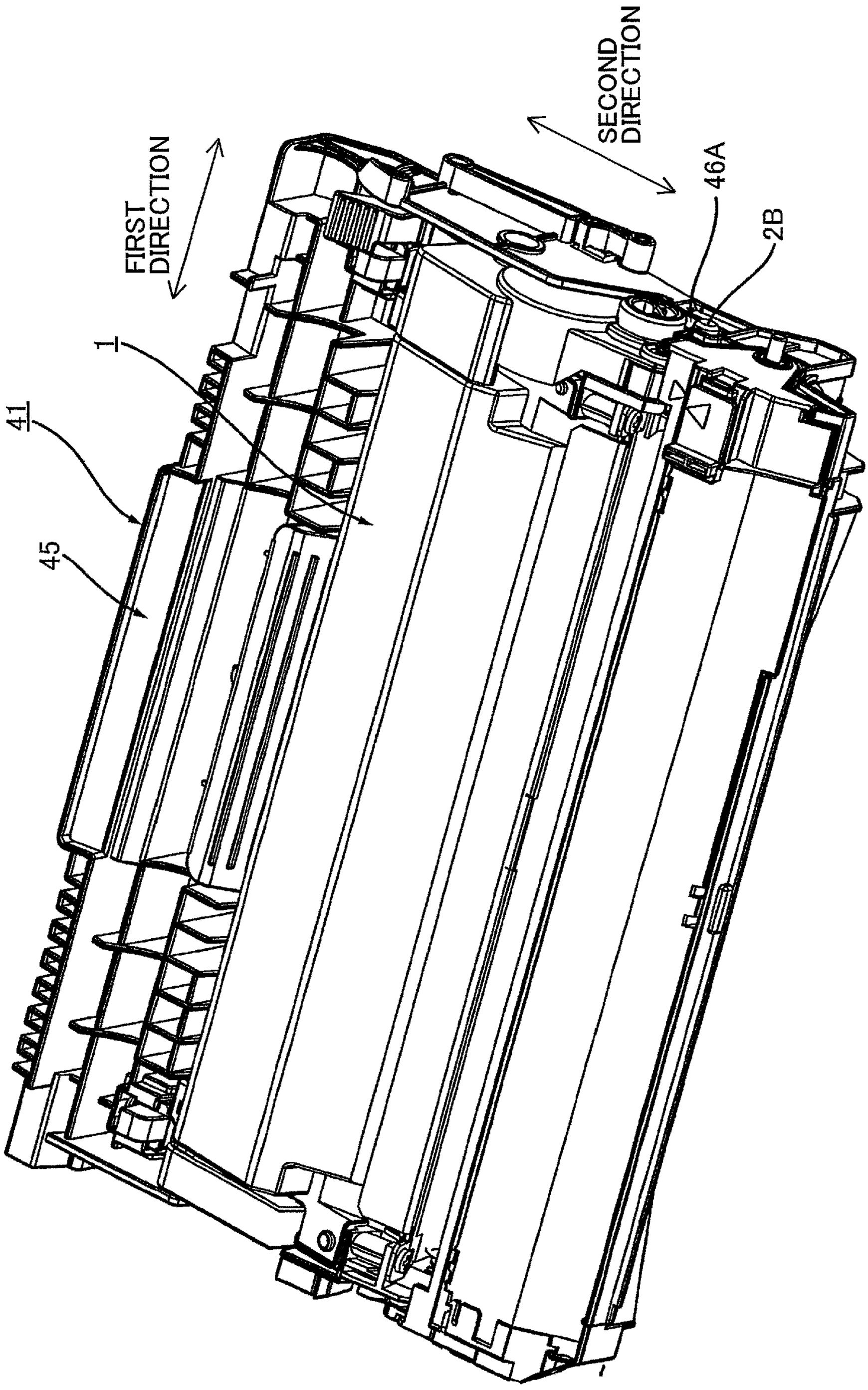
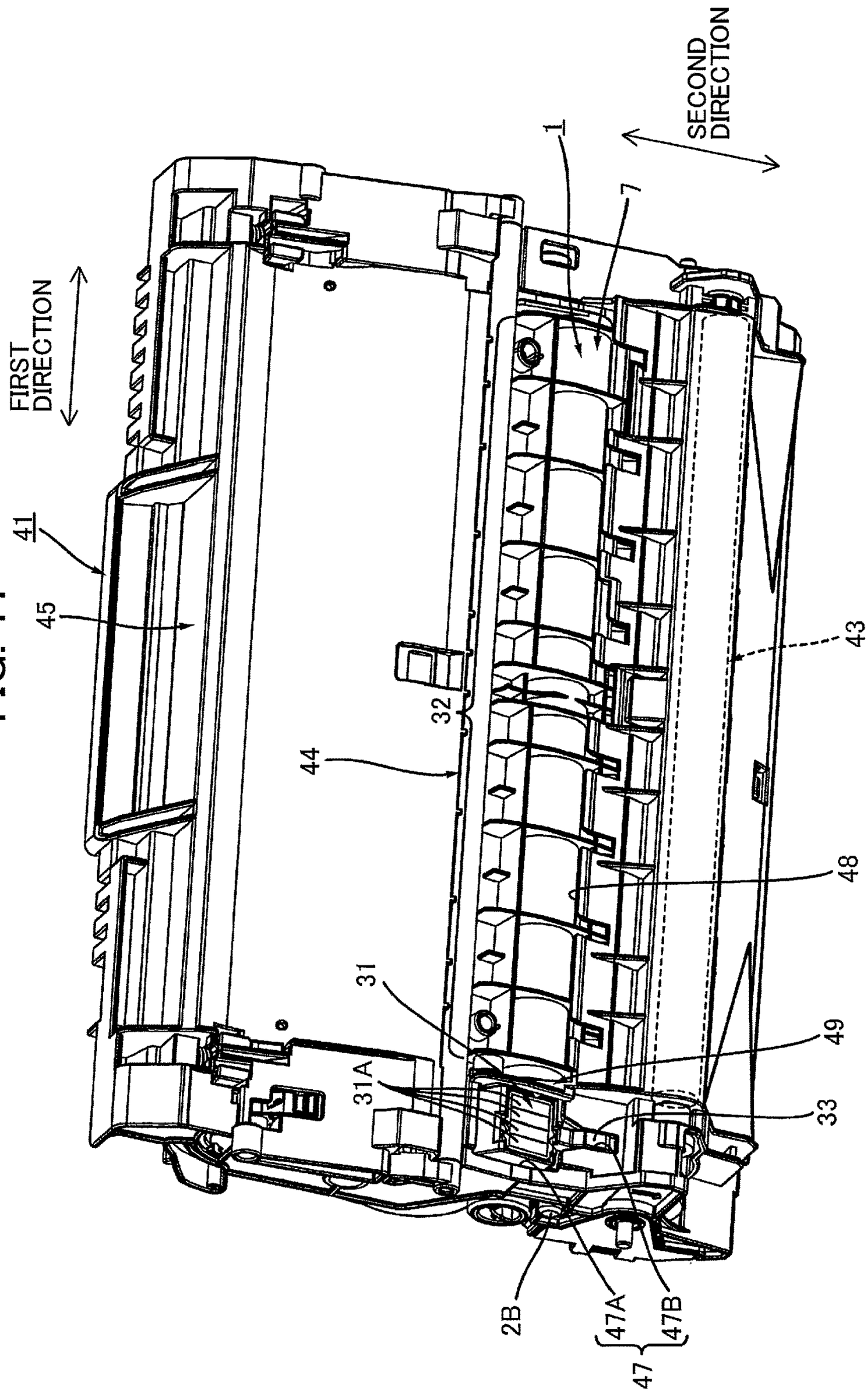


FIG. 10

FIG. 11


FIRST DIRECTION
SECOND DIRECTION
1
7
41
45
44
32
43
48
31
31A
49
33
2B
47A
47B
47

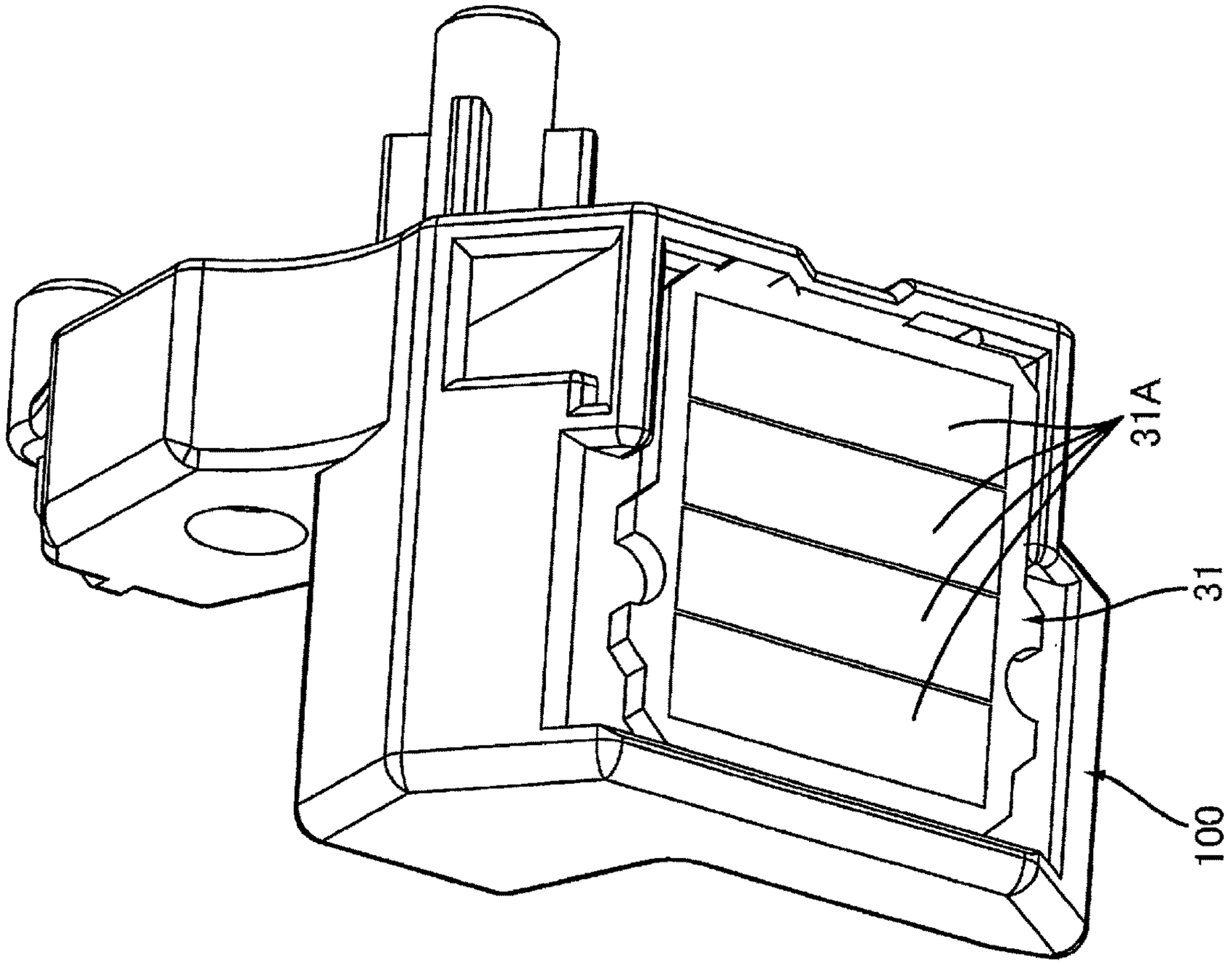


FIG. 12B

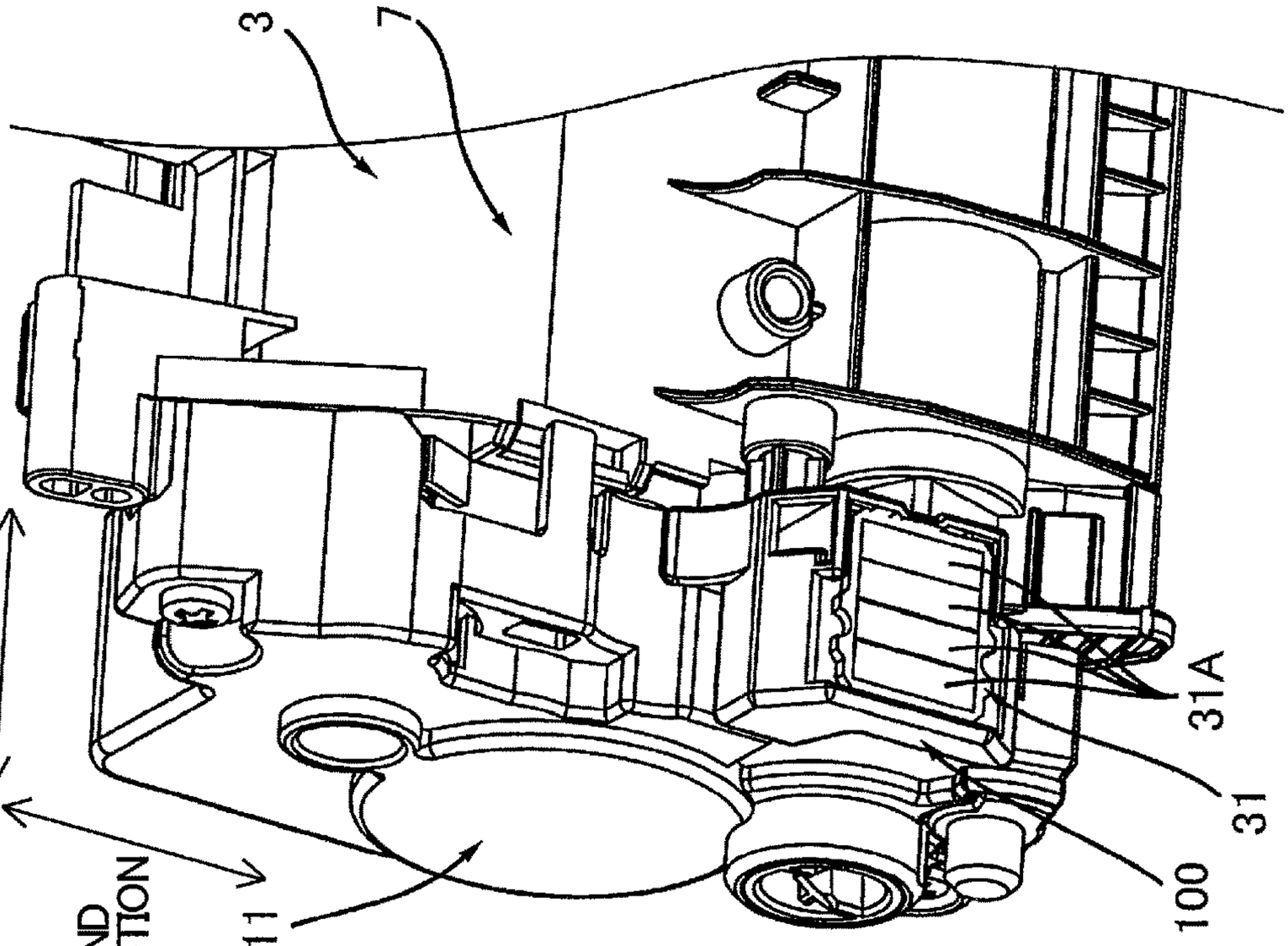


FIG. 12A

FIG. 13A

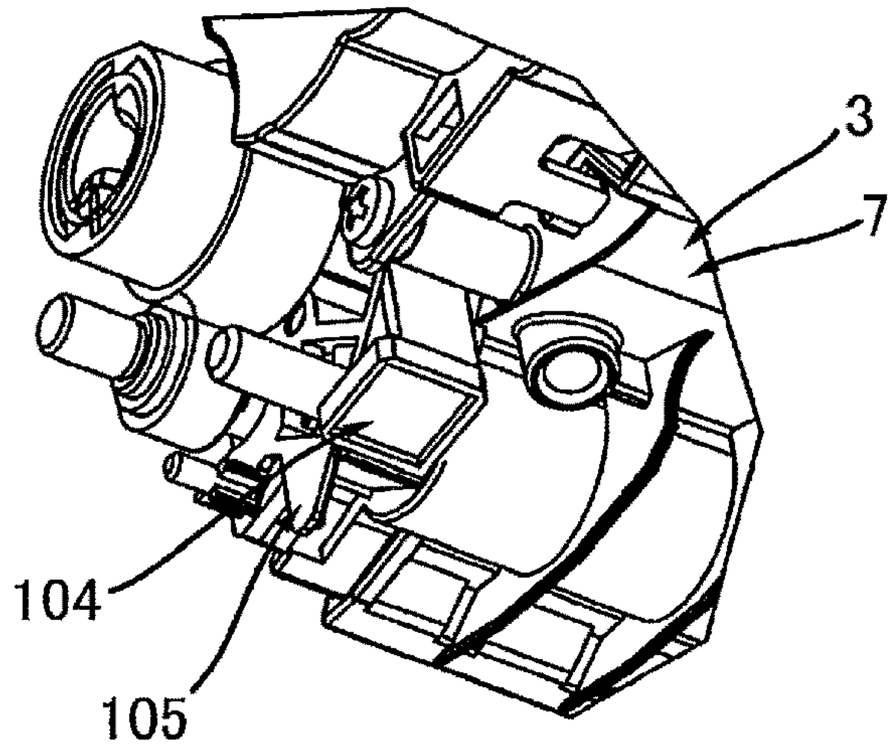


FIG. 13B

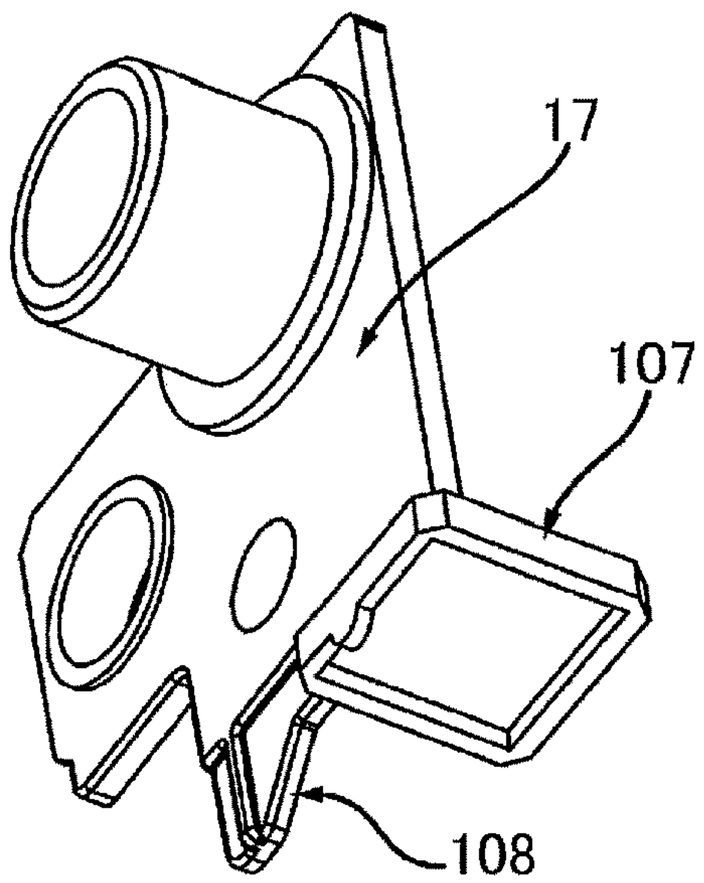


FIG. 13C

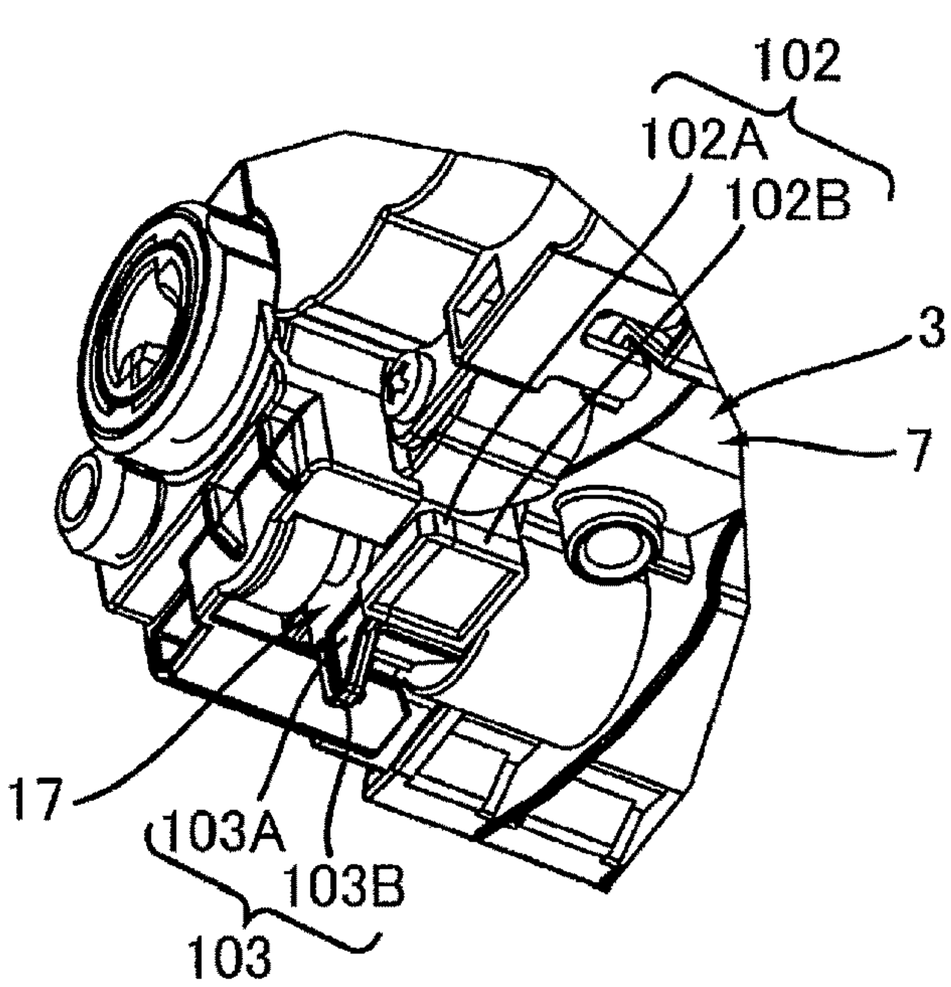


FIG. 14

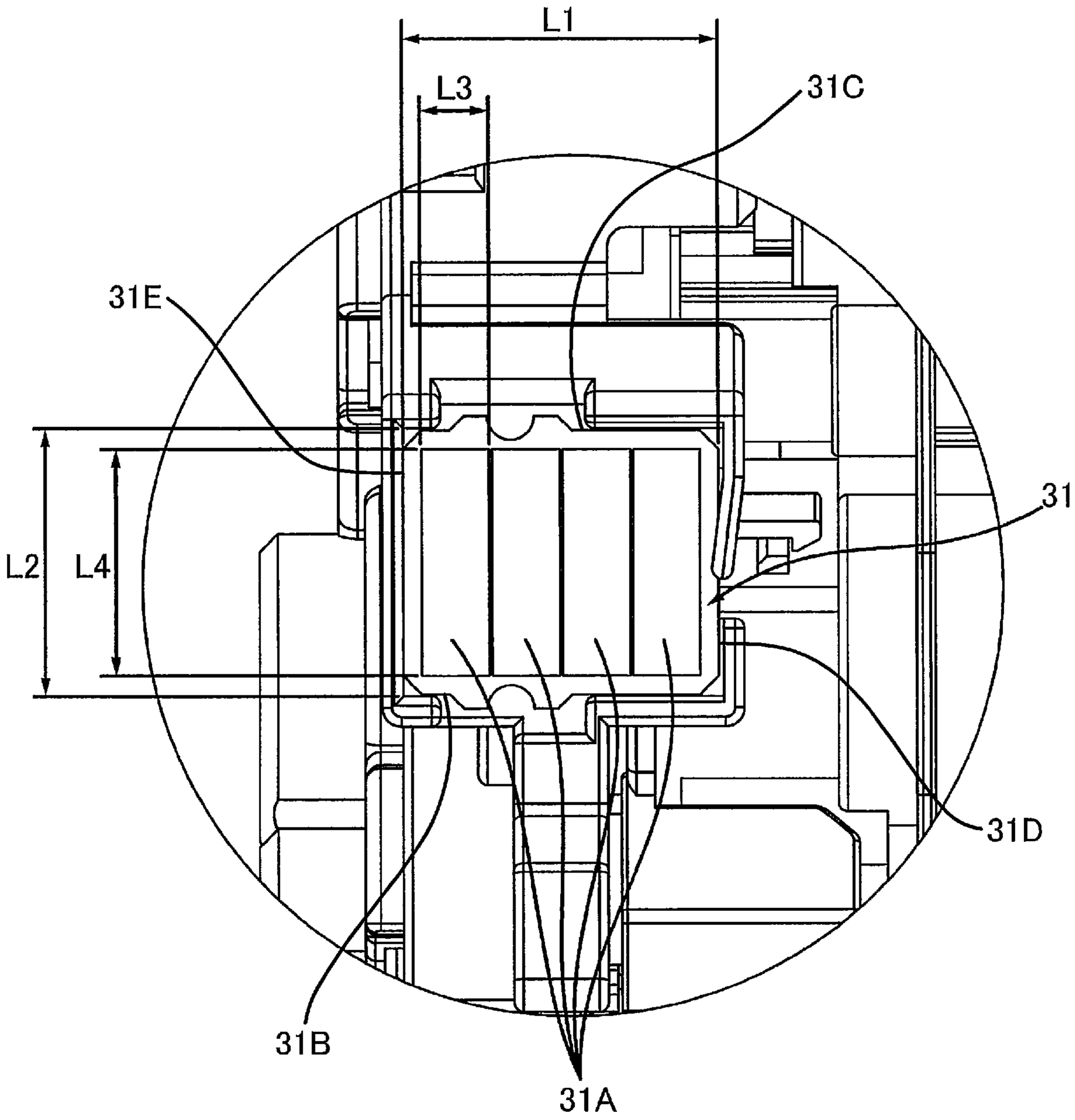


FIG. 15

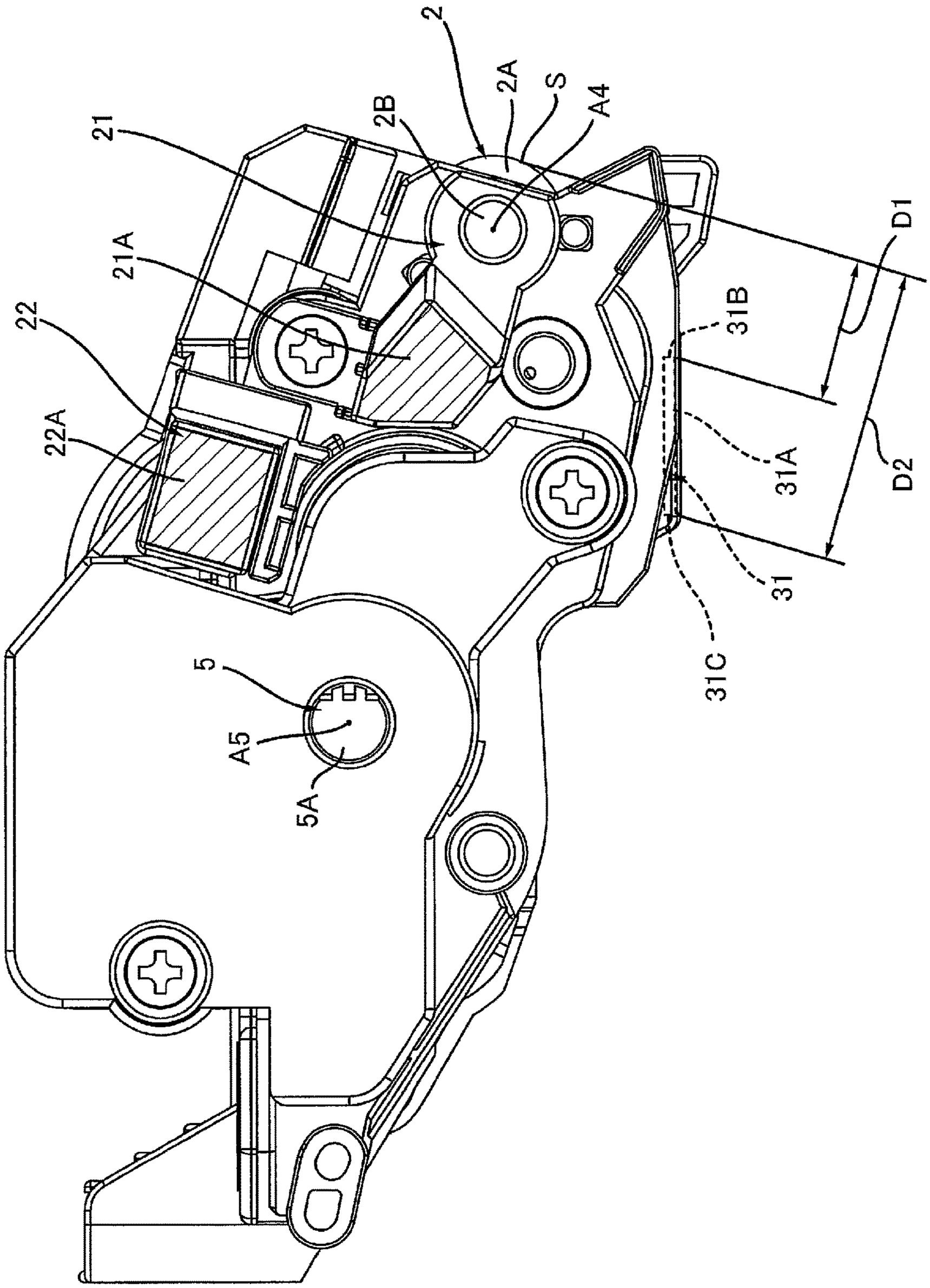


FIG. 16

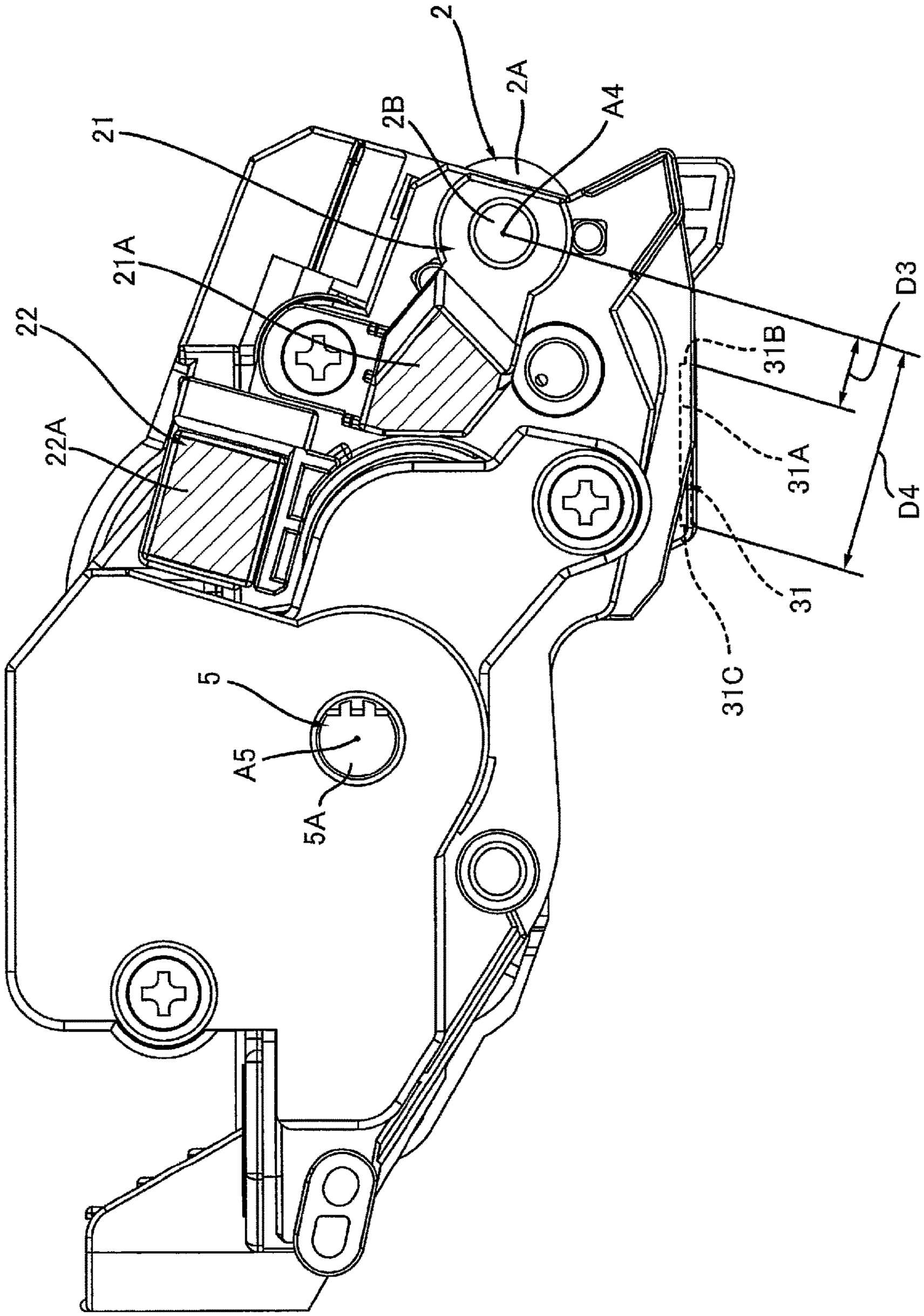


FIG. 17

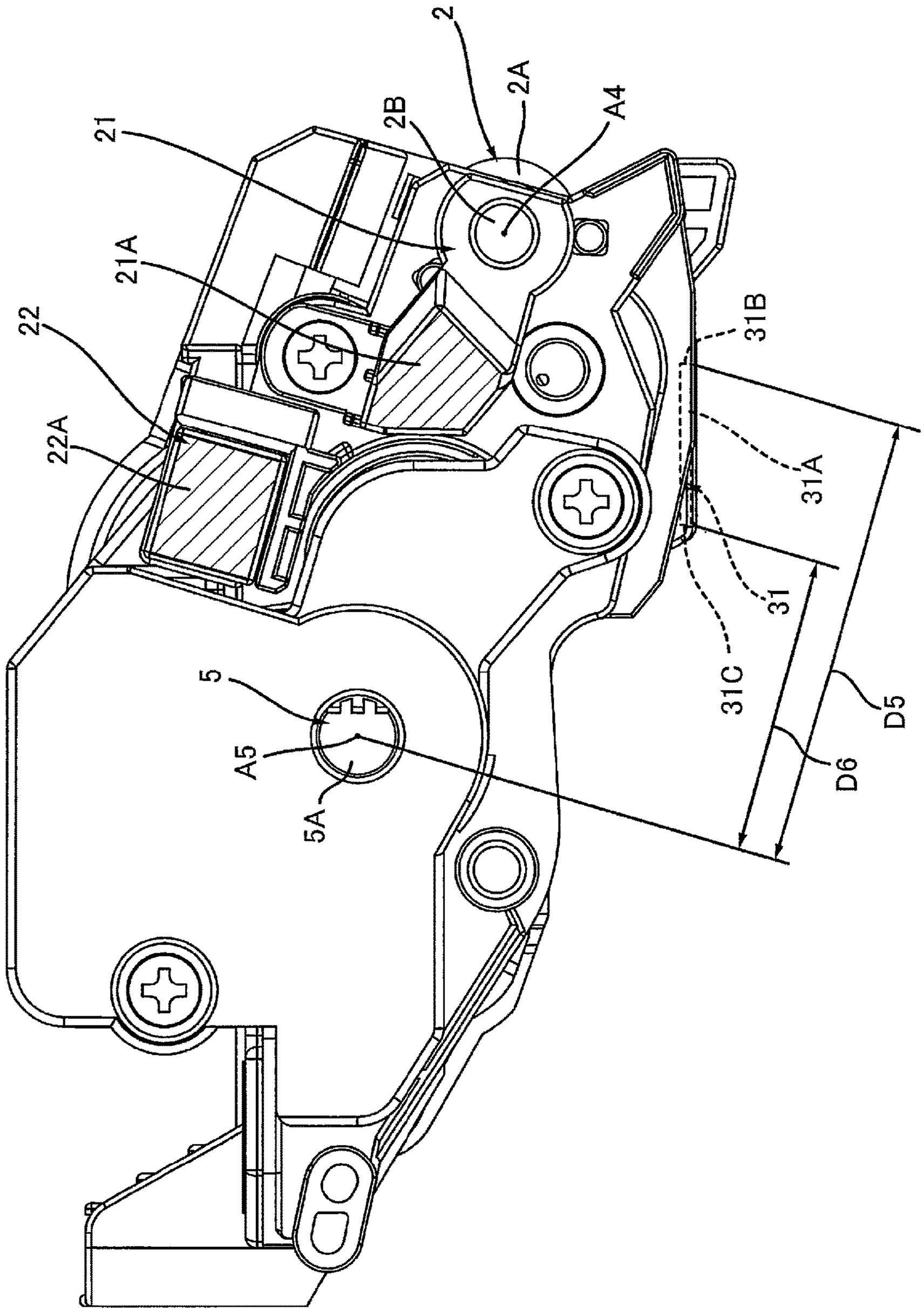
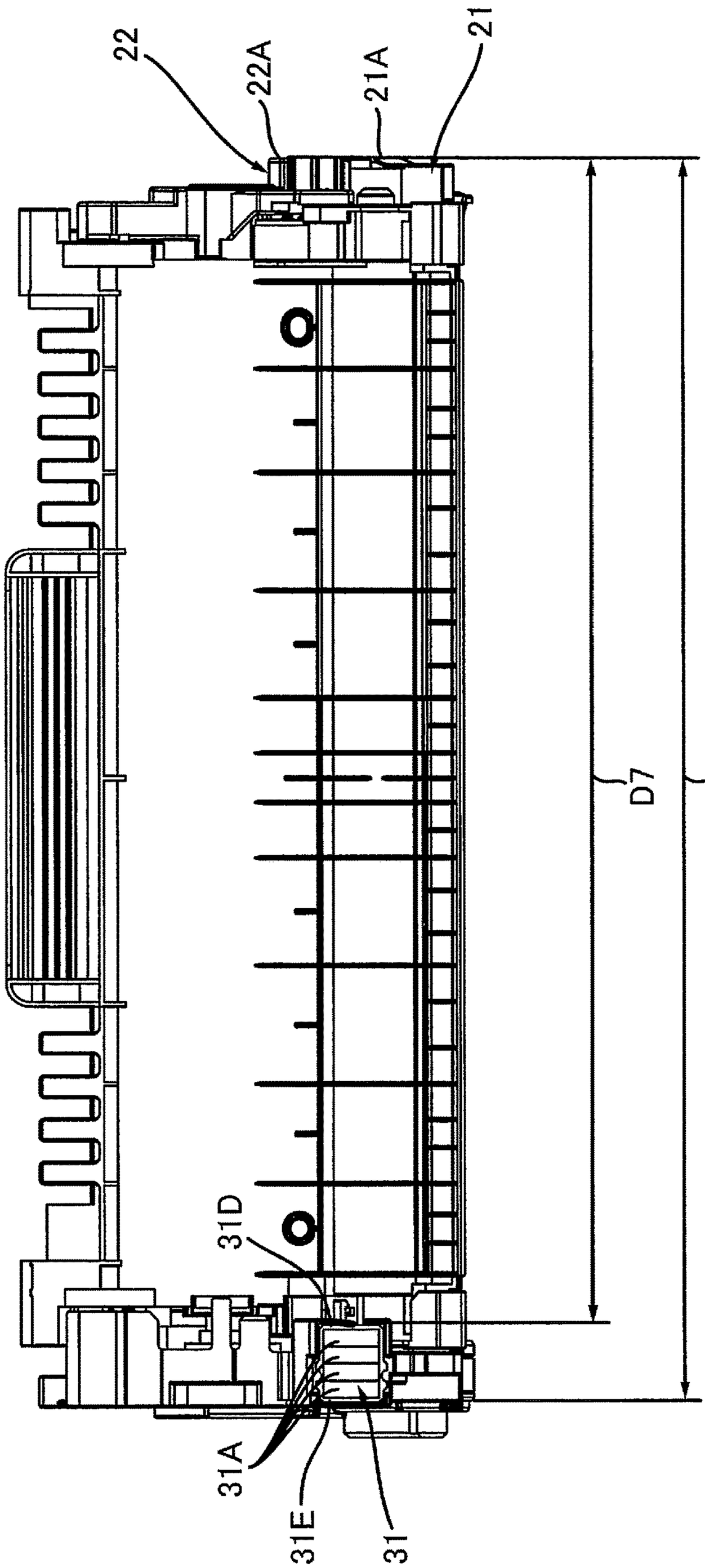


FIG. 18



DRUM CARTRIDGE AND DEVELOPING CARTRIDGE CAPABLE OF SUPPRESSING VARIATION IN POSITION OF ELECTRICAL CONTACT SURFACE

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. patent application Ser. No. 16/692,602, filed Nov. 22, 2019, which is a continuation of U.S. patent application Ser. No. 16/438,882, filed Jun. 12, 2019, which is a continuation of U.S. patent application Ser. No. 16/168,974, filed Oct. 24, 2018, which is a continuation of U.S. patent application Ser. No. 15/472,014 filed Mar. 28, 2017, both of further claim priority from Japanese Patent Application Nos. 2016-202959 filed Oct. 14, 2016 and 2016-249651 filed Dec. 22, 2016. The entire contents of each of these applications is incorporated herein by reference.

TECHNICAL FIELD

The present disclosure relates to a drum cartridge and a developing cartridge.

BACKGROUND

A drum cartridge including a drum frame and a developing cartridge including a developing roller are well known in the art. One such developing cartridge also includes a storage medium having an electrical contact surface. The developing cartridge is attached to the drum frame by inserting the developing cartridge into the drum frame and pivotally moving the developing cartridge about the developing roller relative to the drum frame.

SUMMARY

In a case where the developing cartridge is attached to the drum frame in this way, the position of the electrical contact surface of the storage medium is generally determined by the position of the developing roller.

The electrical contact surface of the storage medium is positioned distant from the developing roller.

Variations in the position of the electrical contact surface are greater as the electrical contact surface is separated farther from the developing roller serving as a positioning reference. Thus, positional variations of the electrical contact surface may arise during manufacturing of the developing cartridges. Consequently, there is greater potential for variations in the position of the electrical contact surface relative to the drum frame in a case where the developing cartridge is attached to the drum frame.

In view of the foregoing, it is an object of the present disclosure to provide a drum cartridge and a developing cartridge capable of suppressing variations in a position of an electrical contact surface relative to the drum frame in a case where the developing cartridge is attached to the drum frame.

In order to attain the above and other objects, according to one aspect, the disclosure provides a drum cartridge including: a drum frame; a photosensitive drum; a transfer roller; and a conveying roller. A developing cartridge is detachably attachable to the drum frame. The developing cartridge includes a storage medium having an electrical contact surface. The drum frame has a first opening. The photosensitive drum is rotatable about a first axis extending in a first direction. The photosensitive drum is positioned at a first end portion of the drum frame in a second direction. The transfer roller is rotatable about a second axis extending in the first direction. The transfer roller is in contact with a surface of the photosensitive drum. The conveying roller is rotatable about a third axis extending in the first direction. The conveying roller is separated from the transfer roller in the second direction. The first opening is positioned between the transfer roller and the conveying roller in the second direction. The electrical contact surface is exposed to an outside of the drum frame through the first opening in a case where the developing cartridge is attached to the drum frame.

According to another aspect, the disclosure provides a developing cartridge including: a casing; a developing roller; an agitator; a developing electrode; and a storage medium. The casing is configured to accommodate toner therein. The casing has a first end portion and a second end portion in a first direction. The casing further has a third end portion and a fourth end portion in a second direction. The developing roller is rotatable about a developing-roller axis extending in the first direction. The developing roller is positioned at the third end portion of the casing. The agitator is rotatable about an agitator axis extending in the first direction. The agitator is separated from the developing roller in the second direction. The developing electrode for supplying electric power to the developing roller is positioned at the second end portion of the casing. The developing electrode is positioned between the developing roller and the agitator in the second direction. The storage medium has an electrical contact surface. The electrical contact surface is positioned at the first end portion of the casing. The electrical contact surface is positioned between the developing roller and the agitator in the second direction.

BRIEF DESCRIPTION OF THE DRAWINGS

The particular features and advantages of the embodiment(s) as well as other objects will become apparent from the following description taken in connection with the accompanying drawings, in which:

FIG. **1** is a perspective view of a developing cartridge according to one embodiment;

FIG. **2** is a schematic cross-sectional view of the developing cartridge taken along a line A-A in FIG. **1**;

FIG. **3** is an exploded perspective view of one end portion of the developing cartridge in FIG. **1**;

FIG. **4** is an exploded perspective view of another end portion of the developing cartridge in FIG. **1**;

FIG. **5** is a side view of the developing cartridge in FIG. **4**, in which a developing-roller bearing, a developing electrode, a supply-roller bearing, and a supply electrode are illustrated;

FIG. **6** is a side view of the developing cartridge in FIG. **1**, in which a storage medium having a plurality of electrical contact surfaces is illustrated;

FIG. **7**A is a perspective view of a gear cover of the developing cartridge in FIG. **6**;

FIG. **7**B is an enlarged perspective view of the plurality of electrical contact surfaces in FIG. **7**A;

FIG. **8** is a perspective view of a drum cartridge to which a developing cartridge is not attached, in which a first opening and a second opening are illustrated;

FIG. **9** is a perspective view of the drum cartridge in FIG. **8**, as viewed in a direction different from FIG. **8**;

FIG. **10** is a perspective view of the drum cartridge to which the developing cartridge has been attached;

FIG. **11** is a perspective view of the drum cartridge in FIG. **9**, as viewed in a direction different from FIG. **10**;

FIG. **12**A is a perspective view of one end portion of a developing cartridge according to a first modification, in which the storage medium having the plurality of electrical contact surfaces is attached to a gear cover through an attachment member;

FIG. **12**B is an enlarged perspective view of the attachment member according to the first modification;

FIG. **13**A is a perspective view of one end portion of a developing cartridge according to a second modification;

FIG. **13**B is a perspective view of a first bearing member of a developing cartridge according to a third modification;

FIG. **13**C is a perspective view of one end portion of a developing cartridge according to a fourth modification;

FIG. **14** is an explanatory view for explaining dimensions of the storage medium having the plurality of electrical contact surfaces;

FIG. **15** is an explanatory view for explaining a position of the plurality of electrical contact surfaces in a second direction with reference to a surface of a developing roller;

FIG. **16** is an explanatory view for explaining a position of the plurality of electrical contact surfaces in the second direction with reference to a developing-roller axis;

FIG. **17** is an explanatory view for explaining a position of the plurality of electrical contact surfaces in the second direction with reference to an agitator axis; and

FIG. **18** is an explanatory view for explaining a position of the plurality of electrical contact surfaces in a first direction with reference to a developing contact surface of the developing electrode and a supply contact surface of the supply electrode.

DETAILED DESCRIPTION

A developing cartridge **1** and a drum cartridge **41** according to one embodiment will be described with reference to the accompanying drawings, wherein like parts and components are designated by the same reference numerals to avoid duplicating description. First, the developing cartridge **1** will be described. Then, the drum cartridge **41** will be described.

1. Overall Structure of Developing Cartridge **1**

FIG. **1** illustrates the developing cartridge **1**. The developing cartridge **1** is attached to a drum frame **45** of the drum cartridge **41** described later, as illustrated in FIG. **10**, and then attached together with the drum cartridge **41** to an image forming apparatus (not illustrated).

The developing cartridge **1** is detachably attachable to the drum frame **45** of the drum cartridge **41** described later. The developing cartridge **1** accommodates toner. The developing cartridge **1** can supply toner to a surface of a photosensitive drum **42** described later (see FIG. **8**). In a case where an electrostatic latent image is formed on the surface of the photosensitive drum **42**, the toner supplied to the surface of the photosensitive drum **42** develops the electrostatic latent image. By developing the electrostatic latent image, a toner image is formed on the surface of the photosensitive drum **42**. Next, a structure of the developing cartridge **1** will be described in detail.

As illustrated in FIG. **1**, the developing cartridge **1** includes a developing roller **2**, a casing **3**, a supply roller **4**, and an agitator **5**.

1.1 Developing Roller **2**

The developing roller **2** is rotatable about a developing-roller axis A**4** extending in a first direction. In a case where the developing cartridge **1** is attached to the drum cartridge **41**, the developing roller **2** contacts the surface of the photosensitive drum **42**. The developing roller **2** can supply toner in the casing **3** to the photosensitive drum **42**.

The developing roller **2** is disposed at one end portion **3**A (i.e. a third end portion) of the casing **3** in a second direction. The developing roller **2** extends in the first direction. The developing roller **2** has a first end portion and a second end portion in the first direction. The first end portion of the developing roller **2** in the first direction is positioned closer to a plurality of electrical contact surfaces **31**A described later (see FIG. **6**) than the second end portion of the developing roller **2** in the first direction is to the plurality of electrical contact surfaces **31**A.

Specifically, the developing roller **2** includes a developing-roller body **2**A, and a developing-roller shaft **2**B. The developing-roller body **2**A extends in the first direction. The developing-roller shaft **2**B is oriented along the developing-roller axis A**4**. That is, the developing-roller shaft **2**B extends in the first direction. The developing-roller body **2**A is rotatable together with the developing-roller shaft **2**B. The developing-roller shaft **2**B has a first end portion and a second end portion in the first direction. The first end portion of the developing-roller shaft **2**B in the first direction is positioned closer to the plurality of electrical contact surfaces **31**A (see FIG. **6**) than the second end portion of the developing-roller shaft **2**B in the first direction is to the plurality of electrical contact surfaces **31**A.

1. 2 Casing **3**

The casing **3** is configured to accommodate toner therein. The casing **3** has one end portion and the other end portion in the first direction. The one end portion of the casing **3** in the first direction will be referred to as a first end portion **3**E, while the other end portion of the casing **3** in the first direction will be referred to as a second end portion **3**F. In addition, the casing **3** has one end portion and the other end portion in the second direction. The one end portion of the casing **3** in the second direction will be referred to as a third end portion **3**A, while the other end portion of the casing **3** in the second direction will be referred to as a fourth end portion **3**B. The second direction is a direction in which the developing roller **2** and the agitator **5** are aligned. The second direction crosses the first direction. More specifically, the second direction is orthogonal to the first direction. The third end portion **3**A of the casing **3** is positioned closer to the developing roller **2** than the fourth end portion **3**B of the casing **3** is to the developing roller **2** in the second direction. A handle **8** is positioned at the fourth end portion **3**B of the casing **3**.

Next, the casing **3** will be described in detail with reference to FIG. **2**. As illustrated in FIG. **2**, the casing **3** includes a first frame **6**, and a second frame **7**. The second frame **7** confronts the first frame **6** in a third direction. The second frame **7** is joined with the first frame **6**. Together the first frame **6** and the second frame **7** define an interior space of the casing **3**. Hereinafter, one end portion of the casing **3** in the third direction will be referred to as a fifth end portion **3**C, while the other end portion of the casing **3** in the third direction will be referred to as a sixth end portion **3**D. The first frame **6** includes the sixth end portion **3**D of the casing **3**. The second frame **7** includes the fifth end portion **3**C of the casing **3**. Hence, the casing **3** has the fifth end portion **3**C and the sixth end portion **3**D with respect to the third direction. The fifth end portion **3**C of the casing **3** is positioned closer to the plurality of electrical contact surfaces **31**A than the sixth end portion **3**D of the casing **3** is to

the plurality of electrical contact surfaces **31**A. The developing roller **2** is mounted at the second frame **7** of the casing **3**.

1.3 Supply Roller **4**

As illustrated in FIG. **1**, the supply roller **4** is rotatable about a supply-roller axis A**6** extending in the first direction. The supply roller **4** is a roller for supplying toner in the casing **3** to the developing roller **2**. A surface of the supply roller **4** contacts a surface of the developing roller **2**.

The supply roller **4** is positioned between the developing roller **2** and the agitator **5** in the second direction. The supply roller **4** extends in the first direction. The supply roller **4** has a first end portion and a second end portion in the first direction. The first end portion of the supply roller **4** in the first direction is positioned closer to the plurality of electrical contact surfaces **31**A (see FIG. **6**) than the second end portion of the supply roller **4** in the first direction is to the plurality of electrical contact surfaces **31**A. Specifically, the supply roller **4** includes a supply-roller body **4**A, and a supply-roller shaft **4**B.

The supply-roller body **4**A extends in the first direction. The supply-roller shaft **4**B is oriented along the supply-roller axis A**6**. That is, the supply-roller shaft **4**B extends in the first direction. The supply-roller body **4**A is rotatable together with the supply-roller shaft **4**B. The supply-roller shaft **4**B includes a first end portion and a second end portion in the first direction. The first end portion of the supply-roller shaft **4**B in the first direction is positioned closer to the plurality of electrical contact surfaces **31**A (see FIG. **6**) than the second end portion of the supply-roller shaft **4**B in the first direction is to the plurality of electrical contact surfaces **31**A.

1.4 Agitator **5**

The agitator **5** can agitate toner in the casing **3**. The agitator **5** can also convey toner in the casing **3** toward the developing roller **2** in the second direction. The agitator **5** is rotatable about an agitator axis A**5** extending in the first direction. The agitator **5** is separated from the developing roller **2** in the second direction. The agitator **5** is positioned inside the casing **3**. The agitator **5** includes an agitator shaft **5**A, and a plurality of blades **5**B.

2. Detailed Description of Developing Cartridge **1**

2.1 Detailed Description of One End Portion of Developing Cartridge **1** in First Direction

Next, one end portion of the developing cartridge **1** in the first direction will be described in detail with reference to FIG. **3**. As illustrated in FIG. **3**, the developing cartridge **1** includes a gear cover **11**, a coupling **12**, a developing gear **13**, a supply gear **14**, an agitator gear **15**, an idle gear **16**, a first bearing member **17**, and a cap **18**. The gear cover **11**, the coupling **12**, the developing gear **13**, the supply gear **14**, the agitator gear **15**, the idle gear **16**, the first bearing member **17**, and the cap **18** are disposed at the one end portion of the casing **3** in the first direction, that is, at the first end portion **3**E of the casing **3**. More specifically, the gear cover **11**, the coupling **12**, the developing gear **13**, the supply gear **14**, the agitator gear **15**, the idle gear **16**, the first bearing member **17**, and the cap **18** are positioned at an outer surface of the first end portion **3**E of the casing **3**.

2.1.1 Gear Cover **1**

As illustrated in FIG. **3**, the gear cover **11** covers at least a portion of a circumference of the developing gear **13**. The gear cover **11** is attached to the first end portion **3**E of the casing **3**. Specifically, the gear cover **11** is attached to the outer surface of the first end portion **3**E of the casing **3**. More specifically, the gear cover **11** is fixed to the outer surface of the first end portion **3**E of the casing **3** by screws **19**.

Note that the term "gear" in the present specification is not limited to a member having gear teeth that transmits rotational force through the gear teeth, but may include a member that transmits rotational force through friction. In the case of members that transmit rotational force through friction, the addendum circle of the gear is defined as the circle passing along the friction-producing surface of the gear.

2.1.2 Coupling **12**

The coupling **12** is rotatable about an axis extending in the first direction. The coupling **12** can rotate in response to a drive force. That is, the coupling **12** can receive a drive force from the image forming apparatus. The coupling **12** can rotate by engaging with a drive member (not illustrated) of the image forming apparatus. The coupling **12** has a recessed portion recessed in the first direction. The recessed portion of the coupling **12** can receive and engage with the drive member. Specifically, the recessed portion of the coupling **12** can engage with the drive member of the image forming apparatus to receive a drive force from the drive member.

2.1.3 Developing Gear **13**

The developing gear **13** is mounted to the first end portion of the developing roller **2** in the first direction. Specifically, the developing gear **13** is mounted to the first end portion of the developing-roller shaft **2**B in the first direction. The developing gear **13** is rotatable together with the developing roller **2**. The developing gear **13** is also rotatable together with the coupling **12**.

2.1.4 Supply Gear **14**

The supply gear **14** is mounted to the first end portion of the supply-roller shaft **4**B of the supply roller **4** in the first direction. The supply gear **14** is rotatable together with the coupling **12**.

2.1.5 Agitator Gear **15**

The agitator gear **15** is mounted to a first end portion of the agitator shaft **5**A of the agitator **5** in the first direction. The agitator gear **15** is rotatable together with the agitator **5** in response to rotation of the coupling **12**.

2.1.6 Idle Gear **16**

The idle gear **16** includes a large-diameter portion **16**A engaging with gear teeth of the coupling **12**, and a small-diameter portion **16**B engaging with gear teeth of the agitator gear **15**. The idle gear **16** is rotatably supported by a shaft (not illustrated) of the gear cover **11**. The idle gear **16** is configured to transmit rotation of the coupling **12** to the agitator gear **15** while reducing the speed of rotation. The large-diameter portion **16**A is separated farther from the casing **3** than the small-diameter portion **16**B is from the casing **3** in the first direction.

2.1.7 First Bearing Member **17**

The first bearing member **17** supports the coupling **12**, the developing gear **13**, and the supply gear **14**. The first bearing member **17** includes a boss **17**A for supporting the coupling **12**. The boss **17**A has a cylindrical shape that extends in the first direction. The first bearing member **17** has a hole **17**B into which the developing-roller shaft **2**B is inserted, and a hole **17**C into which the supply-roller shaft **4**B is inserted. By inserting the first end portion of the developing-roller shaft **2**B in the first direction into the hole **17**B, the first bearing member **17** is attached to the first end portion of the developing-roller shaft **2**B in the first direction. By inserting the first end portion of the supply-roller shaft **4**B in the first direction into the hole **17**C, the first bearing member **17** is attached to the first end portion of the supply-roller shaft **4**B in the first direction.

2.1.8 Cap **18**

The cap **18** covers the first end portion of the developing-roller shaft **2**B in the first direction. Note that the gear cover **11** and the cap **18** may be formed of different types of resin.

2.2 Detailed Description of Other End Portion of Developing Cartridge **1** in First Direction

Next, the other end portion of the developing cartridge **1** in the first direction will be described in detail with reference to FIGS. **4** and **5**. As illustrated in FIG. **4**, the developing cartridge **1** includes a developing electrode **21**, a supply electrode **22**, and a second bearing member **23**. The developing electrode **21**, the supply electrode **22**, and the second bearing member **23** are disposed at the other end portion of the casing **3** in the first direction, that is, at the second end portion **3**F of the casing **3**. That is, the developing electrode **21** and the supply electrode **22** are positioned at the second end portion **3**F of the casing **3**. More specifically, the developing electrode **21**, the supply electrode **22**, and the second bearing member **23** are positioned at an outer surface of the second end portion **3**F of the casing **3**. Hence, the developing electrode **21** and the supply electrode **22** are positioned at the outer surface of the second end portion **3**F of the casing **3**.

2.2.1 Developing Electrode **21**

The developing electrode **21** is an electrode for supplying electric power to the developing roller **2**. Specifically, the developing electrode **21** is configured to supply electric power to the developing-roller shaft **2**B. As illustrated in FIG. **5**, the developing electrode **21** is positioned between the developing roller **2** and the agitator **5** in the second direction. The developing electrode **21** has a portion separated from the developing-roller shaft **2**B in the second direction. As illustrated in FIG. **4**, the developing electrode **21** has a portion separated from an end of the developing-roller shaft **2**B in the first direction. Specifically, the developing electrode **21** protrudes in the first direction such that a distal end of the developing electrode **21** is separated farther from the casing **3** than the end of the developing-roller shaft **2**B in the first direction is from the casing **3**. The developing electrode **21** is formed of an electrically conductive resin, for example.

The developing electrode **21** has a developing contact surface **21**A. The developing contact surface **21**A is in contact with an electrode in the image forming apparatus in a case where the developing cartridge **1** is attached to the image forming apparatus. The developing contact surface **21**A extends in the second direction and the third direction. The developing contact surface **21**A is separated from the developing-roller shaft **2**B in the second direction. The developing contact surface **21**A is also separated from the end of the developing-roller shaft **2**B in the first direction.

The developing electrode **21** also includes a developing contact **21**B, and a coupling portion **21**C. The developing contact **21**B contacts the developing-roller shaft **2**B. The coupling portion **21**C is electrically connected to the developing contact **21**B and the developing contact surface **21**A.

The developing contact **21**B has a contact hole **21**D. The second end portion of the developing-roller shaft **2**B in the first direction is inserted into the contact hole **21**D. Accordingly, the developing contact **21**B functions as a bearing for the developing-roller shaft **2**B. In other words, the developing electrode **21** includes a developing-roller bearing attached to the second end portion of the developing-roller shaft **2**B in the first direction. Thus, the developing cartridge **1** includes the developing-roller bearing. The contact hole **21**D is preferably a circular-shaped hole. In a case where the developing-roller shaft **2**B is inserted into the contact hole **21**D, the developing contact **21**B is in contact with the second end portion of the developing-roller shaft **2**B in the first direction. Specifically, the developing contact **21**B is in contact with an outer circumferential surface of the second end portion of the developing-roller shaft **2**B in the first direction in case where the developing-roller shaft **2**B is inserted into the contact hole **21**D. Accordingly, the developing contact **21**B is attached to the second end portion of the developing-roller shaft **2**B in the first direction. That is, the developing contact **21**B is attached to the second end portion of the developing roller **2** in the first direction. Further, the developing contact **21**B is aligned with the developing contact surface **21**A in the second direction. Accordingly, the developing contact surface **21**A is separated from the developing-roller shaft **2**B in the second direction.

The developing contact surface **21**A of the developing electrode **21** is in contact with the electrode in the image forming apparatus in a case where the developing cartridge **1** is attached to the image forming apparatus. Accordingly, in a case where receiving electric power from the image forming apparatus, the developing electrode **21** can supply electric power to the developing roller **2**.

2.2.2 Supply Electrode **22**

The supply electrode **22** is an electrode for supplying electric power to the supply roller **4**. Specifically, the supply electrode **22** is configured to supply electric power to the supply-roller shaft **4**B. As illustrated in FIG. **5**, the supply electrode **22** is positioned between the developing electrode **21** and the agitator **5** in the second direction. The supply electrode **22** has a portion separated from the supply-roller shaft **4**B in the second direction. As illustrated in FIG. **4**, the supply electrode **22** is separated from the end of the developing-roller shaft **2**B in the first direction. Specifically, the supply electrode **22** protrudes in the first direction such that a distal end of the supply electrode **22** is separated farther from the casing **3** than the end of the developing-roller shaft **2**B in the first direction is from the casing **3**. The supply electrode **22** is formed of an electrically conductive resin, for example.

The supply electrode **22** has a supply contact surface **22**A. The supply contact surface **22**A is in contact with an electrode in the image forming apparatus in a case where the developing cartridge **1** is attached to the image forming apparatus. The supply contact surface **22**A extends in the second direction and the third direction. The supply contact surface **22**A is separated from the supply-roller shaft **4**B in the second direction. Further, the supply contact surface **22**A is separated from the end of the supply-roller shaft **4**B in the first direction.

The supply electrode **22** also includes a supply contact **22**B, and a coupling portion **22**C. The supply contact **22**B contacts the supply-roller shaft **4**B. The coupling portion **22**C is electrically connected to the supply contact surface **22**A and the supply contact **22**B.

The supply contact **22**B has a contact hole **22**D. The second end portion of the supply-roller shaft **4**B in the first direction is inserted into the contact hole **22**D. Accordingly, the supply contact **22**B functions as a bearing for the supply-roller shaft **4**B. In other words, the supply electrode **22** includes a supply-roller bearing attached to the second end portion of the supply-roller shaft **4**B in the first direction. Thus, the developing cartridge **1** includes the supply-roller bearing. The contact hole **22**D is preferably a circular-shaped hole. In a case where the supply-roller shaft **4**B is inserted into the contact hole **22**D, the supply contact **22**B is in contact with the second end portion of the supply-roller

shaft **4**B in the first direction. Specifically, the supply contact **22**B is in contact with an outer circumferential surface of the second end portion of the supply-roller shaft **4**B in the first direction in a case where the supply-roller shaft **4**B is inserted into the contact hole **22**D. That is, the supply contact **22**B is attached to the second end portion of the supply-roller shaft **4**B in the first direction. Further, the supply contact **22**B is aligned with the supply contact surface **22**A in the second direction. Accordingly, the supply contact surface **22**A is separated from the supply-roller shaft **4**B in the second direction.

The electrode in the image forming apparatus is in contact with the supply contact surface **22**A of the supply electrode **22** in a case where the developing cartridge **1** is attached to the image forming apparatus. Accordingly, in a case where receiving electric power from the image forming apparatus, the supply electrode **22** can supply electric power to the supply roller **4**.

2.2.3 Second Bearing Member **23**

The second bearing member **23** includes a first support portion **23**A, and a second support portion **23**B. The first support portion **23**A rotatably supports the developing-roller shaft **2**B. The second support portion **23**B rotatably supports the supply-roller shaft **4**B. While supporting the developing-roller shaft **2**B and the supply-roller shaft **4**B, the second bearing member **23** is fixed to the outer surface of the second end portion **3**F of the casing **3**.

The second bearing member **23** is fixed together with the developing electrode **21** and the supply electrode **22** to the outer surface of the second end portion **3**F of the casing **3** by screws **24**.

2.3 Detailed Description of One End Portion of Developing Cartridge **1** in Third Direction

Next, one end portion of the developing cartridge **1** in the third direction will be described in detail with reference to FIGS. **6**, **7**A, and **7**B. The developing cartridge **1** includes a storage medium **31**, and a plurality of ribs **32**.

2.3.1 Storage Medium **31**

The storage medium **31** is an integrated circuit. The storage medium **31** has at least one electrical contact surface **31**A. Note that the electrical contact surface **31**A may be singular or plural. In the present embodiment, the storage medium **31** has a plurality of, that is, four, electrical contact surfaces **31**A. The four electrical contact surfaces **31**A are arrayed in the first direction.

Specifically, as illustrated in FIG. **7**B, the storage medium **31** includes a SIO (data) terminal **31A1**, a GND (ground) terminal **31A2**, a SCK (serial clock) terminal **31A3**, and a PWR (power) terminal **31A4**. Hence, a surface of the SIO (data) terminal **31A1** constitutes one of the four electrical contact surfaces **31**A, a surface of the GND (ground) terminal **31A2** constitutes another of the four electrical contact surfaces **31**A, a surface of the SCK (serial clock) terminal **31A3** constitutes another of the four electrical contact surfaces **31**A, and a surface of the PWR (power) terminal **31A4** constitutes the other of the four electrical contact surfaces **31**A.

In the present embodiment, the four electrical contact surfaces **31**A are arrayed in the first direction such that the SIO (data) terminal **31A1**, the GND (ground) terminal **31A2**, the SCK (serial clock) terminal **31A3**, and the PWR (power) terminal **31A4** are arrayed in the first direction in this order.

However, the SIO (data) terminal **31A1**, the GND (ground) terminal **31A2**, the SCK (serial clock) terminal **31A3**, and the PWR (power) terminal **31A4** may be arrayed in the first direction in any order.

For example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the SIO (data) terminal **31A1**, the GND (ground) terminal **31A2**, the PWR (power) terminal **31A4**, and the SCK (serial clock) terminal **31A3** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the SIO (data) terminal **31A1**, the SCK (serial clock) terminal **31A3**, the GND (ground) terminal **31A2**, and the PWR (power) terminal **31A4** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the SIO (data) terminal **31A1**, the SCK (serial clock) terminal **31A3**, the PWR (power) terminal **31A4**, and the GND (ground) terminal **31A2** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the SIO (data) terminal **31A1**, the PWR (power) terminal **31A4**, the GND (ground) terminal **31A2**, and the SCK (serial clock) terminal **31A3** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the SIO (data) terminal **31A1**, the PWR (power) terminal **31A4**, the SCK (serial clock) terminal **31A3**, and the GND (ground) terminal **31A2** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the GND (ground) terminal **31A2**, the SIO (data) terminal **31A1**, the SCK (serial clock) terminal **31A3**, and the PWR (power) terminal **31A4** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the GND (ground) terminal **31A2**, the SIO (data) terminal **31A1**, the PWR (power) terminal **31A4**, and the SCK (serial clock) terminal **31A3** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the GND (ground) terminal **31A2**, the SCK (serial clock) terminal **31A3**, the SIO (data) terminal **31A1**, and the PWR (power) terminal **31A4** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the GND (ground) terminal **31A2**, the SCK (serial clock) terminal **31A3**, the PWR (power) terminal **31A4**, and the SIO (data) terminal **31A1** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the GND (ground) terminal **31A2**, the PWR (power) terminal **31A4**, the SIO (data) terminal **31A1**, and the SCK (serial clock) terminal **31A3** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the GND (ground) terminal **31A2**, the PWR (power) terminal **31A4**, the SCK (serial clock) terminal **31A3**, and the SIO (data) terminal **31A1** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the SCK (serial clock) terminal **31A3**, the SIO (data) terminal **31A1**, the GND (ground) terminal **31A2**, and the PWR (power) terminal **31A4** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the SCK (serial clock) terminal **31A3**, the SIO (data) terminal **31A1**, the PWR (power) terminal **31A4**, and the GND (ground) terminal **31A2** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the SCK

(serial clock) terminal **31A3**, the GND (ground) terminal **31A2**, the SIO (data) terminal **31A1**, and the PWR (power) terminal **31A4** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the SCK (serial clock) terminal **31A3**, the GND (ground) terminal **31A2**, the PWR (power) terminal **31A4**, and the SIO (data) terminal **31A1** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the SCK (serial clock) terminal **31A3**, the PWR (power) terminal **31A4**, the SIO (data) terminal **31A1**, and the GND (ground) terminal **31A2** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the SCK (serial clock) terminal **31A3**, the PWR (power) terminal **31A4**, the GND (ground) terminal **31A2**, and the SIO (data) terminal **31A1** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the PWR (power) terminal **31A4**, the SIO (data) terminal **31A1**, the GND (ground) terminal **31A2**, and the SCK (serial clock) terminal **31A3** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the PWR (power) terminal **31A4**, the SIO (data) terminal **31A1**, the SCK (serial clock) terminal **31A3**, and the GND (ground) terminal **31A2** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the PWR (power) terminal **31A4**, the GND (ground) terminal **31A2**, the SIO (data) terminal **31A1**, and the SCK (serial clock) terminal **31A3** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the PWR (power) terminal **31A4**, the GND (ground) terminal **31A2**, the SCK (serial clock) terminal **31A3**, and the SIO (data) terminal **31A1** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the PWR (power) terminal **31A4**, the SCK (serial clock) terminal **31A3**, the SIO (data) terminal **31A1**, and the GND (ground) terminal **31A2** are arrayed in the first direction in this order.

Further, for example, the four electrical contact surfaces **31**A are arrayed in the first direction such that the PWR (power) terminal **31A4**, the SCK (serial clock) terminal **31A3**, the GND (ground) terminal **31A2**, and the SIO (data) terminal **31A1** are arrayed in the first direction in this order.

The plurality of electrical contact surfaces **31**A is positioned at the one end portion of the casing **3** in the third direction. Specifically, the plurality of electrical contact surfaces **31**A is positioned at the fifth end portion **3**C of the casing **3**. More specifically, the storage medium **31** including the plurality of electrical contact surfaces **31**A is positioned at an outer surface of the fifth end portion **3**C of the casing **3**.

The fifth end portion **3**C of the casing **3** is positioned closer to the plurality of electrical contact surfaces **31**A than the sixth end portion **3**D of the casing **3** is to the plurality of electrical contact surfaces **31**A. That is, the outer surface of the fifth end portion **3**C of the casing **3** is positioned closer to the storage medium **31** including the plurality of electrical contact surfaces **31**A than an outer surface of the sixth end portion **3**D of the casing **3** is to the storage medium **31**.

The plurality of electrical contact surfaces **31**A is also positioned at the one end portion of the casing **3** in the first direction. That is, the plurality of electrical contact surfaces **31**A is positioned at the first end portion **3**E of the casing **3**. Specifically, the plurality of electrical contact surfaces **31**A is positioned at an outer surface of the gear cover **11**. More specifically, the plurality of electrical contact surfaces **31**A is positioned at an outer surface of one end portion of the gear cover **11** in the third direction. In other words, the plurality of electrical contact surfaces **31**A is positioned at an outer surface of the casing **3** via the gear cover **11**. Specifically, the plurality of electrical contact surfaces **31**A is positioned at the outer surface of the first end portion **3**E of the casing **3** via the gear cover **11**. Note that the storage medium **31** having the plurality of electrical contact surfaces **31**A is fixed to the outer surface of the gear cover **11** with adhesive. Thus, the gear cover **11** includes the plurality of electrical contact surfaces **31**A.

The gear cover **11** further includes a protrusion **33**. Hence, the developing cartridge **1** includes the protrusion **33**. In a case where the developing cartridge **1** is attached to the drum frame **45** described later (see FIG. **8**), the protrusion **33** is fitted into a first opening **47** (described later) of the drum frame **45** (see FIG. **8**). Fitting the protrusion **33** into the first opening **47** fixes the position of the developing cartridge **1** relative to the drum cartridge **41**. The protrusion **33** is aligned with the plurality of electrical contact surfaces **31**A in the second direction. That is, the plurality of electrical contact surfaces **31**A is aligned with the protrusion **33** in the second direction. The protrusion **33** is positioned closer to the developing roller **2** than the plurality of electrical contact surfaces **31**A is to the developing roller **2** in the second direction.

2.3.2 Plurality of Ribs **32**

The plurality of ribs **32** (see FIGS. **6** and **11**) is positioned to be capable of contacting sheets of paper conveyed by a conveying roller **44** described later (see FIGS. **8** and **9**). Through this contact with the sheets of paper, the plurality of ribs **32** guides the sheets of paper to a position between the photosensitive drum **42** and a transfer roller **43** described later while reducing an area of contact between the casing **3** and the sheets of paper.

The plurality of ribs **32** each protrudes outward from the outer surface of the casing **3** in the third direction. Specifically, the plurality of ribs **32** each protrudes outward from the second frame **7** of the casing **3** in the third direction. Hence, the second frame **7** includes the plurality of ribs **32**. Each of the plurality of ribs **32** extends in the second direction.

The plurality of ribs **32** is aligned with each other in the first direction. Specifically, the plurality of ribs **32** is arranged at intervals in the first direction. The plurality of ribs **32** is also aligned with the plurality of electrical contact surfaces **31**A in the first direction. The plurality of ribs **32** is aligned with the plurality of electrical contact surfaces **31**A and at least a portion of the developing electrode **21** in the first direction. Further, the plurality of ribs **32** is aligned with the plurality of electrical contact surfaces **31**A and at least a portion of the supply electrode **22** in the first direction. Further, a dimension L**5** in the first direction of a set of the plurality of ribs **32** is greater than a dimension in the first direction of the sheets of paper conveyed by the conveying roller **44**. The dimension L**5** in the first direction of a set of the plurality of ribs **32** is shorter than a dimension in the first direction of the developing-roller body **2**A. The dimension L**5** in the first direction of a set of the plurality of ribs **32** is greater than a dimension L**6** in the first direction of a set of the plurality of electrical contact surfaces **31**A.

2.4 Positional Relationships of Electrical Contact Surfaces **31**A, Developing Roller **2**, Agitator **5**, Developing Electrode **21**, and Supply Electrode **22**

Next, the positional relationships of the plurality of electrical contact surfaces **31**A, the developing roller **2**, the agitator **5**, the developing electrode **21**, and the supply electrode **22** will be described with reference to FIG. **5**.

The plurality of electrical contact surfaces **31**A is positioned between the developing roller **2** and the agitator **5** in the second direction. Specifically, the plurality of electrical contact surfaces **31**A is positioned between the developing-roller axis A**4** and the agitator axis A**5** in the second direction.

The plurality of electrical contact surfaces **31**A is disposed at a position corresponding to both the developing electrode **21** and the supply electrode **22** in the third direction. In other words, when projected in the first direction, the plurality of electrical contact surfaces **31**A is disposed at a position overlapping both the developing electrode **21** and the supply electrode **22** in the third direction. Specifically, the plurality of electrical contact surfaces **31**A is aligned with the developing electrode **21** and the supply electrode **22** in the third direction when viewed in the first direction. That is, when projected in the first direction, the plurality of electrical contact surfaces **31**A is aligned in the third direction with a first end portion of the developing electrode **21** in the second direction. In other words, the plurality of electrical contact surfaces **31**A is aligned in the third direction with at least a portion of the developing electrode **21** when viewed in the first direction. Further, when projected in the first direction, the plurality of electrical contact surfaces **31**A is aligned in the third direction with at least a portion of the supply electrode **22**. That is, the plurality of electrical contact surfaces **31**A is disposed at a position corresponding to both the developing contact surface **21**A and the supply contact surface **22**A in the third direction when viewed in the first direction.

3. Overall Structure of Drum Cartridge **41**

Next, the structure of the drum cartridge **41** will be described with reference to FIGS. **8** and **9**. The drum cartridge **41** includes the photosensitive drum **42**, the transfer roller **43**, the conveying roller **44**, and the drum frame **45**.

3.1 Photosensitive Drum **42**

The photosensitive drum **42** is positioned at a first end portion **45**A of the drum frame **45** in the second direction. The photosensitive drum **42** is rotatable about a first axis A**1** extending in the first direction. An electrostatic latent image is formed on the surface of the photosensitive drum **42** during an image forming operation.

3.2 Transfer Roller **43**

The transfer roller **43** can transfer a toner image from the surface of the photosensitive drum **42** onto a sheet of paper. The transfer roller **43** is rotatable about a second axis A**2** extending in the first direction. The transfer roller **43** contacts the surface of the photosensitive drum **42**.

3.3 Conveying Roller **44**

The conveying roller **44** is a roller for conveying sheets of paper to a position between the photosensitive drum **42** and the transfer roller **43**. The conveying roller **44** is rotatable about a third axis A**3** extending in the first direction. The conveying roller **44** is separated from the transfer roller **43** in the second direction.

3.4 Drum Frame **45**

The drum frame **45** has the first end portion **45**A and a second end portion **45**B in the second direction. The first end portion **45**A of the drum frame **45** is positioned closer to the photosensitive drum **42** than the second end portion **45**B of the drum frame **45** is to the photosensitive drum **42** in the second direction.

Both end portions of the drum frame **45** in the first direction are respectively provided with guides **46**A and **46**B. The end portions of the developing-roller shaft **2**B in the first direction are fitted into the corresponding guides **46**A and **46**B in a case where the developing cartridge **1** is attached to the drum frame **45**. More specifically, one end portion **45**C of the drum frame **45** in the first direction has the guide **46**A in which the first end portion of the developing-roller shaft **2**B in the first direction is fitted, and another end portion **45**D of the drum frame **45** in the first direction has the guide **46**B in which the second end portion of the developing-roller shaft **2**B in the first direction is fitted. The drum frame **45** also has the first opening **47**, and a second opening **48**. The drum frame **45** further includes a guide frame **49**.

3.4.1 First Opening **47**

The first opening **47** serves both to expose the plurality of electrical contact surfaces **31**A to the outside of the drum frame **45** and to receive the protrusion **33** in a fitted state in a case where the developing cartridge **1** is attached to the drum frame **45**. In this way, the plurality of electrical contact surfaces **31**A is in contact with electrodes of the image forming apparatus through the first opening **47** in a case where the developing cartridge **1** is attached to the image forming apparatus. The first opening **47** will be described later in detail with reference to FIGS. **10** and **11**.

3.4.2 Second Opening **48**

The second opening **48** allows sheets of paper conveyed by the conveying roller **44** to pass therethrough and to direct the sheets of paper to the area of contact between the photosensitive drum **42** and the transfer roller **43**. More specifically, the second opening **48** exposes the plurality of ribs **32** to the outside of the drum frame **45** in a case where the developing cartridge **1** is attached to the drum frame **45**. Accordingly, in a case where the developing cartridge **1** is attached to the image forming apparatus, a sheet of paper conveyed by the conveying roller **44** contacts the plurality of ribs **32** exposed through the second opening **48**. The conveyed sheet subsequently passes through the second opening **48** toward the area of contact between the photosensitive drum **42** and the transfer roller **43**. The second opening **48** will be described later in detail with reference to FIGS. **10** and **11**.

3.4.3 Guide Frame **49**

The guide frame **49** can guide the sheets of paper conveyed by the conveying roller **44**. The guide frame **49** will also be described later in detail with reference to FIGS. **10** and **11**.

3.5 Attached State of Developing Cartridge **1** to Drum Cartridge **41**

Next, the positions and functions of the first opening **47**, the second opening **48**, and the guide frame **49** in a case where the developing cartridge **1** is attached to the drum frame **45** will be described with reference to FIGS. **10** and **11**.

First, an operation for attaching the developing cartridge **1** to the drum frame **45** will be described. The developing cartridge **1** is attached to the drum cartridge **41** by pivotally moving the developing cartridge **1** relative to the drum cartridge **41** about the developing-roller shaft **2**B. Specifically, in order to attach the developing cartridge **1** to the drum frame **45**, the both end portions of the developing-roller shaft **2**B are fitted in the corresponding guides **46**A and **46**B of the drum frame **45** (see FIGS. **8** and **9**). From this

state, the developing cartridge **1** is pivotally moved about the developing-roller shaft **2**B relative to the drum cartridge **41**. Through this action, the drum frame **45** faces the second frame **7** of the developing cartridge **1** in the third direction, at which time the developing cartridge **1** is fixed in position relative to the drum frame **45**. This completes the operation for attaching the developing cartridge **1** to the drum frame **45**.

In this state, the plurality of electrical contact surfaces **31**A is exposed to the outside of the drum frame **45** through the first opening **47**. That is, the plurality of electrical contact surfaces **31**A is exposed to the outside of the drum frame **45** through the first opening **47** in a case where the developing cartridge **1** is attached to the drum frame **45**. Specifically, the plurality of electrical contact surfaces **31**A is exposed to the outside of the drum frame **45** through the first opening **47** in a case where the developing cartridge **1** is pivotally moved relative to the drum frame **45** about the developing-roller shaft **2**B and attached to the drum frame **45**.

Next, the drum cartridge **41** and the developing cartridge **1** are attached together into the image forming apparatus. Since the image forming apparatus has a plurality of electrodes, each of the plurality of electrical contact surfaces **31**A contacts corresponding one of the plurality of electrodes in the image forming apparatus. Thus, the number of electrodes in the image forming apparatus is equal to the number of electrical contact surfaces **31**A. Since the storage medium **31** of the developing cartridge **1** has four electrical contact surfaces **31**A in the present embodiment, the image forming apparatus has four electrodes.

As illustrated in FIG. **11**, the first opening **47** is positioned between the transfer roller **43** and the conveying roller **44** in the second direction. The first opening **47** is positioned at the one end portion **45**C of the drum frame **45** in the first direction. A dimension of the first opening **47** in the first direction is greater than the dimension L**6** of a set of the four electrical contact surfaces **31**A in the first direction. The first opening **47** has a first region **47**A, and a second region **47**B.

The first region **47**A of the first opening **47** exposes the plurality of electrical contact surfaces **31**A to the outside of the drum frame **45** in a case where the developing cartridge **1** is attached to the drum cartridge **41**. Thus, a dimension of the first region **47**A in the first direction is greater than the dimension L**6** of a set of the four electrical contact surfaces **31**A in the first direction. The protrusion **33** of the developing cartridge **1** (see FIG. **6**) is fitted into the second region **47**B in a case where the developing cartridge **1** is attached to the drum frame **45**. The second region **47**B is aligned with the first region **47**A in the second direction. The second region **47**B is positioned opposite to the conveying roller **44** with respect to the first region **47**A in the second direction. A dimension of the second region **47**B in the first direction is smaller than the dimension of the first region **47**A in the first direction.

The second opening **48** is positioned between the transfer roller **43** and the conveying roller **44** in the second direction. The second opening **48** is aligned with the first opening **47** in the first direction. A dimension of the second opening **48** in the first direction is greater than the dimension L**5** of a set of the plurality of ribs **32** in the first direction. The dimension of the second opening **48** in the first direction is approximately equal to a dimension of the transfer roller **43** in the first direction.

The guide frame **49** is positioned between the first opening **47** and the second opening **48** in the first direction. The guide frame **49** extends in the second direction. Note that the guide frame **49** also functions as a reinforcing frame for strengthening the drum frame **45**. In other words, the drum frame **45** includes a reinforcing frame. The reinforcing frame is positioned between the first opening **47** and the second opening **48** in the first direction.

4. Operational Advantages

The drum cartridge **41** according to the embodiment has the first opening **47** for exposing the plurality of electrical contact surfaces **31**A, as illustrated in FIGS. **8** through **11**.

With this configuration, the plurality of electrical contact surfaces **31**A can be exposed to the outside of the drum cartridge **41** through the first opening **47** in a case where the developing cartridge **1** is attached to the drum frame **45**.

Further, the first opening **47** is positioned between the transfer roller **43** and the conveying roller **44**. Hence, the first opening **47** is positioned in proximity to the photosensitive drum **42**. Specifically, the first opening **47** is disposed at a position close to the developing roller **2** in case where the developing cartridge **1** is attached to the drum frame **45**. In other words, the plurality of electrical contact surfaces **31**A is positioned close to the developing roller **2** in case where the developing cartridge **1** is attached to the drum frame **45**.

Hence, this arrangement reduces the distance between the developing roller **2** and the plurality of electrical contact surfaces **31**A, and specifically reduces the tolerance for the distance between the developing roller **2** and the plurality of electrical contact surfaces **31**A.

Thus, variations in the position of the plurality of electrical contact surfaces **31**A produced when manufacturing the developing cartridge **1** can be decreased, for example, thereby suppressing variations in the position of the plurality of electrical contact surfaces **31**A relative to the drum frame **45** in case where the developing cartridge **1** is attached to the drum frame **45**. More specifically, this configuration can suppress variations in the position of the plurality of electrical contact surfaces **31**A relative to the drum frame **45** in case where the developing cartridge **1** is attached to the drum frame **45** by first fitting the end portions of the developing roller **2** into the end portions of the drum frame **45** and subsequently pivotally moving the developing cartridge **1** relative to the drum frame **45** about the developing roller **2**.

In the developing cartridge **1** according to the embodiment, the plurality of electrical contact surfaces **31**A is positioned between the developing roller **2** and the agitator **5** in the second direction, as illustrated in FIG. **5**. Hence, in a case where the developing cartridge **1** is attached to the drum frame **45**, the plurality of electrical contact surfaces **31**A is positioned in proximity to the developing roller **2**.

Accordingly, this arrangement reduces the distance between the developing roller **2** and the plurality of electrical contact surfaces **31**A, and specifically reduces the tolerance for the distance between the developing roller **2** and the plurality of electrical contact surfaces **31**A.

Thus, variations in the position of the plurality of electrical contact surfaces **31**A produced when manufacturing the developing cartridge **1** can be decreased, for example, thereby suppressing variations in the position of the plurality of electrical contact surfaces **31**A relative to the drum frame **45** in a case where the developing cartridge **1** is attached to the drum frame **45**. More preferably, this configuration can suppress variations in the position of the plurality of electrical contact surfaces **31**A relative to the drum frame **45** in a case where the developing cartridge **1** is attached to the drum frame **45** by first fitting the end portions of the developing roller **2** into the end portions of the drum frame

45 and subsequently pivotally moving the developing cartridge 1 relative to the drum frame 45 about the developing roller 2.

Further, the plurality of electrical contact surfaces 31A is positioned at the first end portion 3E of the casing 3 in the first direction, while the developing electrode 21 and the supply electrode 22 are positioned at the second end portion 3F of the casing 3 in the first direction.

This arrangement prevents the electric power supplied to the developing electrode 21 and the supply electrode 22 from being transmitted to the plurality of electrical contact surfaces 31A.

Accordingly, this configuration suppresses malfunctions in the storage medium 31 that may be caused by electric power supplied to the developing electrode 21 and the supply electrode 22 being transmitted to the storage medium 31.

Further, the plurality of ribs 32 is aligned with the plurality of electrical contact surfaces 31A in the first direction.

Therefore, the plurality of electrical contact surfaces 31A is positioned outside the sheets of paper being conveyed by the conveying roller 44.

This arrangement prevents the plurality of electrical contact surfaces 31A from interfering with the sheets of paper conveyed by the conveying roller 44.

Further, a portion of the developing cartridge 1 between the developing roller 2 and the agitator 5 is exposed to the outside of the drum frame 45 through the second opening 48 of the drum cartridge 41 in a case where the developing cartridge 1 is attached to the drum cartridge 41. Here, the plurality of electrical contact surfaces 31A is positioned between the developing roller 2 and the agitator 5 in the second direction, but is positioned outside the portion between the developing roller 2 and the agitator 5 in the first direction. The sheets of paper being conveyed by the conveying roller 44 pass through the second opening 48 of the drum cartridge 41. The sheets of paper being conveyed by the conveying roller 44 pass through between the photosensitive drum 42 and the transfer roller 43.

As described above, the plurality of electrical contact surfaces 31A is positioned between the developing roller 2 and the agitator 5 in the second direction and outside the portion between the developing roller 2 and the agitator 5 in the first direction. This arrangement enables the plurality of electrical contact surfaces 31A to contact electrodes in the image forming apparatus while not interfering with the conveyance of sheets of paper when the conveying roller 44 conveys sheets of paper to the position between the photosensitive drum 42 and transfer roller 43.

5. Modifications

Next, modifications of the embodiment will be described with reference to FIGS. 12A through 13C.

5.1 First Modification

First modification will be described while referring to FIGS. 12A and 12B, wherein like parts and components to those in the embodiment are designated with the same reference numerals to avoid duplicating description.

The storage medium 31 having the plurality of electrical contact surfaces 31A may not necessarily be fixed to the outer surface of the gear cover 11 with adhesive. Instead, the storage medium 31 having the plurality of electrical contact surfaces 31A may be fixed to an outer surface of an attachment member 100 with adhesive and may be subsequently attached to the outer surface of the gear cover 11 through the attachment member 100, as illustrated in FIGS. 12A and 12B. The attachment member 100 is a separate member from the gear cover 11. Hence, the storage medium 31 having the plurality of electrical contact surfaces 31A can be replaced by replacing the attachment member 100 supporting the storage medium 31 having the electrical contact surfaces 31A rather than replacing the entire gear cover 11.

Alternatively, the attachment member 100 may be attached to the outer surface of the casing 3 rather than the gear cover 11.

5.2 Second Modification

Second modification will be described while referring to FIG. 13A, wherein like parts and components to those in the embodiment are designated with the same reference numerals to avoid duplicating description.

The storage medium 31 having the plurality of electrical contact surfaces 31A may be supported at the casing 3 instead of being fixed to the outer surface of the gear cover 11 with adhesive. Specifically, the casing 3 may include the plurality of electrical contact surfaces 31A. As illustrated in FIG. 13A, the casing 3 includes an attachment portion 104 to which the storage medium 31 having the plurality of electrical contact surfaces 31A is attached.

In addition, the developing cartridge 1 may include a protrusion 105 in place of the protrusion 33. The protrusion 105 protrudes from the casing 3.

5.3 Third Modification

Third modification will be described while referring to FIG. 13B, wherein like parts and components to those in the embodiment are designated with the same reference numerals to avoid duplicating description.

The storage medium 31 having the plurality of electrical contact surfaces 31A may be supported at the first bearing member 17 instead of being fixed to the outer surface of the gear cover 11 with adhesive. Specifically, the first bearing member 17 may include the plurality of electrical contact surfaces 31A. As illustrated in FIG. 13B, the first bearing member 17 includes an attachment portion 107. The storage medium 31 having the plurality of electrical contact surfaces 31A is attached to the attachment portion 107.

In addition, the developing cartridge 1 may include a protrusion 108 in place of the protrusion 33. The protrusion 108 protrudes from the first bearing member 17. In other words, the first bearing member 17 may include the protrusion 108.

5.4 Fourth Modification

Fourth modification will be described while referring to FIG. 13C, wherein like parts and components to those in the embodiment are designated with the same reference numerals to avoid duplicating description.

The storage medium 31 having the plurality of electrical contact surfaces 31A may be supported by both the first bearing member 17 and the casing 3 instead of being fixed to the outer surface of the gear cover 11 with adhesive. Specifically, the first bearing member 17 may include a first attachment portion 102A, as illustrated in FIG. 13C. Further, the casing 3 may include a second attachment portion 102B. The first attachment portion 102A and the second attachment portion 102B are connected to each other in the first direction. Together the first attachment portion 102A and the second attachment portion 102B constitute an attachment portion 102. The storage medium 31 having the plurality of electrical contact surfaces 31A is attached to both the first attachment portion 102A and the second attachment portion 102B, i.e., the attachment portion 102.

In addition, the developing cartridge 1 may include a protrusion 103 in place of the protrusion 33. The protrusion

103 includes a first protrusion 103A protruding from the first bearing member 17, and a second protrusion 103B protruding from the casing 3.

5.5 Fifth Modification

In a fifth modification, the guide frame 49 may be eliminated from the drum frame 45. Specifically, the first opening 47 may be in communication with the second opening 48. More specifically, the first opening 47 may include the second opening 48.

6. Dimensions of Storage Medium 31

Next, the dimensions of the storage medium 31 will be described in detail with reference to FIG. 14. The following dimensions of the storage medium 31 may be applied to the embodiment and any of the modifications described above.

A length L1 of the storage medium 31 in the first direction is 16.85 mm.

A length L2 of the storage medium 31 in the second direction is 14 mm. Note that, as illustrated in FIG. 14, the length L2 is a length in the second direction of the storage medium 31 excluding projecting portions of the storage medium 31.

A length L3 of each of the plurality of electrical contact surfaces 31A in the first direction is 3.6 mm.

A length L4 of each of the plurality of electrical contact surfaces 31A in the second direction is 12 mm.

The four electrical contact surfaces 31A are arranged at intervals of 0.15 mm in the first direction.

7. Positioning of Electrical Contact Surfaces 31

Next, the positioning of the plurality of electrical contact surfaces 31A will be described in detail with reference to FIGS. 15 through 18. Note that the following positioning of the plurality of electrical contact surfaces 31A may be applied to the embodiment and any of the modifications described above.

As illustrated in FIG. 15, a distance in the second direction from a set of the plurality of electrical contact surfaces 31A to a surface S of the developing roller 2 may be in a range from 11 mm to 26 mm. In other words, at least a portion of the plurality of electrical contact surfaces 31A is positioned within a range from 11 mm to 26 mm from the surface S of the developing roller 2 in the second direction. That is, at least a portion of the plurality of electrical contact surfaces 31A is distant from the surface S of the developing roller 2 in the second direction by a distance ranging from 11 mm to 26 mm. Note that the surface S of the developing roller 2 denotes a portion on the circumferential surface of the developing roller 2 that is separated farthest from the agitator axis A5.

More specifically, the storage medium 31 has a first edge 31B and a second edge 31C in the second direction. The second edge 31C is separated from the first edge 31B in the second direction. The second edge 31C is positioned between the agitator gear 15 and the first edge 31B in the second direction. A distance D1 in the second direction between the first edge 31B of the storage medium 31 and the surface S of the developing roller 2 is 11.924 mm. A distance D2 in the second direction between the second edge 31C of the storage medium 31 and the surface S of the developing roller 2 is 25.355 mm. An outer diameter of the developing roller 2 is 13 mm.

In this case, the plurality of electrical contact surfaces 31A in its entirety is positioned within the range from 11 mm to 26 mm from the surface S of the developing roller 2 in the second direction.

Further, a distance in the second direction from a set of the plurality of electrical contact surfaces 31A to the developing-roller axis A4 may be in a range from 5 mm to 19 mm, as illustrated in FIG. 16. In other words, at least a portion of the plurality of electrical contact surfaces 31A is positioned within a range from 5 mm to 19 mm from the developing-roller axis A4 in the second direction. That is, at least a portion of the plurality of electrical contact surfaces 31A is distant from the developing-roller axis A4 in the second direction by a distance ranging from 5 mm to 19 mm.

More specifically, a distance D3 in the second direction between the first edge 31B of the storage medium 31 and the developing-roller axis A4 is 5.424 mm. A distance D4 in the second direction between the second edge 31C of the storage medium 31 and the developing-roller axis A4 is 18.855 mm.

In this case, the plurality of electrical contact surfaces 31A in its entirety is positioned within the range from 5 mm to 19 mm from the developing-roller axis A4 in the second direction.

Further, a distance in the second direction from a set of the plurality of electrical contact surfaces 31A to the agitator axis A5 may be in a range from 26 mm to 40 mm, as illustrated in FIG. 17. In other words, at least a portion of the plurality of electrical contact surfaces 31A is positioned within a range from 26 mm to 40 mm from the agitator axis A5 in the second direction. That is, at least a portion of the plurality of electrical contact surfaces 31A is distant from the agitator axis A5 in the second direction by a distance ranging from 26 mm to 40 mm.

More specifically, a distance D5 in the second direction between the first edge 31B of the storage medium 31 and the agitator axis A5 is 39.515 mm. Further, a distance D6 in the second direction between the second edge 31C of the storage medium 31 and the agitator axis A5 is 26.084 mm.

In this case, the plurality of electrical contact surfaces 31A in its entirety is positioned within the range from 26 mm to 40 mm from the agitator axis A5 in the second direction.

Further, a distance in the first direction from a set of the plurality of electrical contact surfaces 31A to the developing contact surface 21A may be in a range from 226 mm to 244 mm, as illustrated in FIG. 18. In other words, at least a portion of the plurality of electrical contact surfaces 31A is positioned within a range from 226 mm to 244 mm from the developing contact surface 21A in the first direction. That is, at least a portion of the plurality of electrical contact surfaces 31A is distant from the developing contact surface 21A in the first direction by a distance ranging from 226 mm to 244 mm.

More specifically, the storage medium 31 has a first end 31D and a second end 31E in the first direction. The second end 31E is separated from the first end 31D in the first direction. The second end 31E is positioned opposite to the developing contact surface 21A with respect to the first end 31D in the first direction. A distance D7 in the first direction between the first end 31D of the storage medium 31 and the developing contact surface 21A is 226.25 mm. Further, a distance D8 in the first direction between the second end 31E of the storage medium 31 and the developing contact surface 21A is 243.10 mm.

In this case, the plurality of electrical contact surfaces 31A in its entirety is positioned within the range from 226 mm to 244 mm from the developing contact surface 21A in the first direction.

Further, a distance in the first direction from a set of the plurality of electrical contact surfaces 31A to the supply contact surface 22A may be in a range from 226 mm to 244 mm. In other words, at least a portion of the plurality of electrical contact surfaces 31A is positioned within a range from 226 mm to 244 mm from the supply contact surface 22A in the first direction. That is, at least a portion of the

plurality of electrical contact surfaces **31**A is distant from the supply contact surface **22**A in the first direction by a distance ranging from 226 mm to 244 mm.

More specifically, a distance in the first direction between the first end **31**D of the storage medium **31** and the supply contact surface **22**A is 226.25 mm, which is identical to the distance D**7** between the first end **31**D of the storage medium **31** and the developing contact surface **21**A. Further, a distance in the first direction between the second end **31**E of the storage medium **31** and the supply contact surface **22**A is 243.10 mm, which is identical to the distance D**8** between the second end **31**E of the storage medium **31** and the developing contact surface **21**A.

In this case, the plurality of electrical contact surfaces **31**A in its entirety is positioned within the range from 226 mm to 244 mm from the supply contact surface **22**A in the first direction.

While the description has been made in detail with reference to the embodiments thereof, it would be apparent to those skilled in the art that many modifications and variations may be made therein without departing from the spirit of the disclosure.

What is claimed is:

1. A cartridge for use with an image forming apparatus, the cartridge accommodating toner, the cartridge comprising:

a housing;

a developing roller rotatable about a first axis extending in a first direction;

a cover positioned at an outer surface of the housing in the first direction;

a storage medium having a plurality of electrical contact surfaces, the plurality of electrical surfaces being aligned in the first direction, the storage medium configured to store information regarding the cartridge, the storage medium being positioned at an outer surface of the cover; and

a protrusion positioned at the outer surface of the cover, the protrusion protruding from the outer surface of the cover, the protrusion positioned at one side of the storage medium in a second direction crossing in the first direction, and the protrusion extending in the second direction,

wherein the protrusion is configured to be fitted into an opening of a component of the image forming apparatus, thereby allowing a position of the cartridge to be fixed relative to the component of the image forming apparatus.

2. The cartridge according to claim **1**,

wherein the storage medium and the protrusion are positioned at a bottom side of the housing.

3. The cartridge according to claim **1**,

wherein the protrusion is aligned with the plurality of electrical contact surfaces in the second direction.

4. The cartridge according to claim **1**,

wherein the housing is configured to accommodate toner therein.

5. The cartridge according to claim **1**,

wherein the cover is a gear cover.

6. The cartridge according to claim **1**,

wherein the component of the image forming apparatus is a drum cartridge.

7. The cartridge according to claim **6**,

wherein the drum cartridge includes a photosensitive drum.

8. The cartridge according to claim **1**,

wherein the housing includes one side in the second direction and another side separated from the one side in the second direction,

wherein the cartridge further comprises:

a handle positioned at the one side of the housing in the second direction,

wherein the protrusion and the storage medium are positioned closer to the another side of the housing than to the one side of the housing in the second direction.

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